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ILLUMINATING ENGINEERING

Journal of the
ILLUMINATING ENGINEERING SOCIETY

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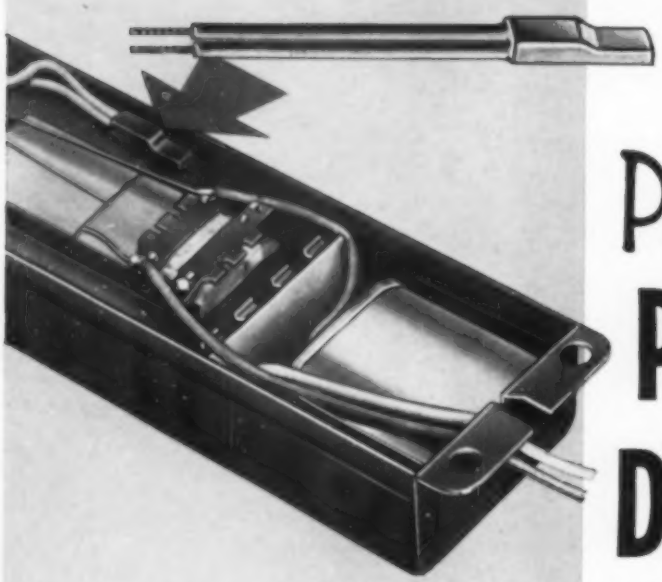

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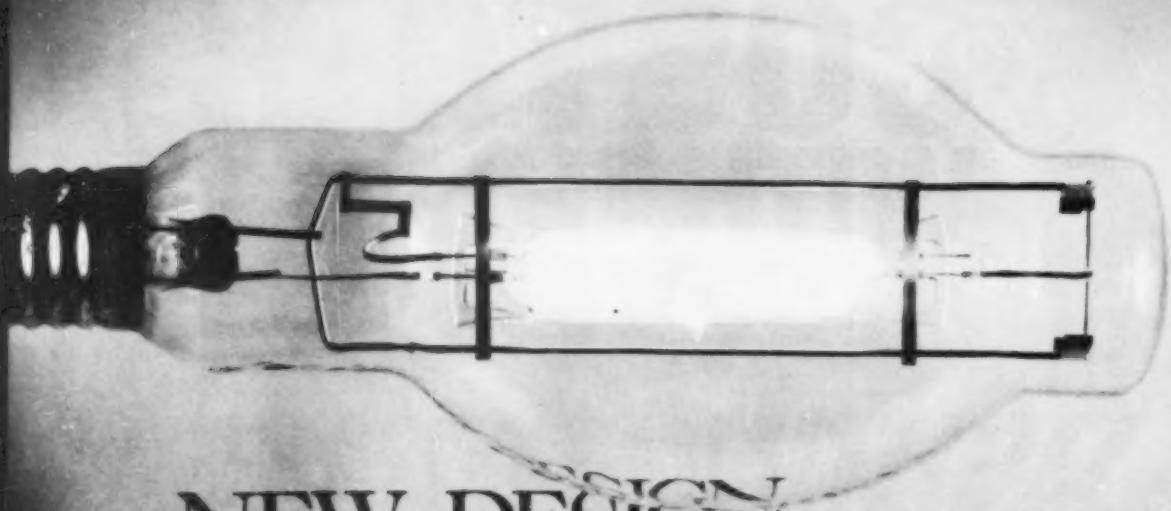

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ILLUMINATING ENGINEERING

THE JOURNAL OF THE ILLUMINATING ENGINEERING SOCIETY

September 1961

Vol. LVI, No. 9

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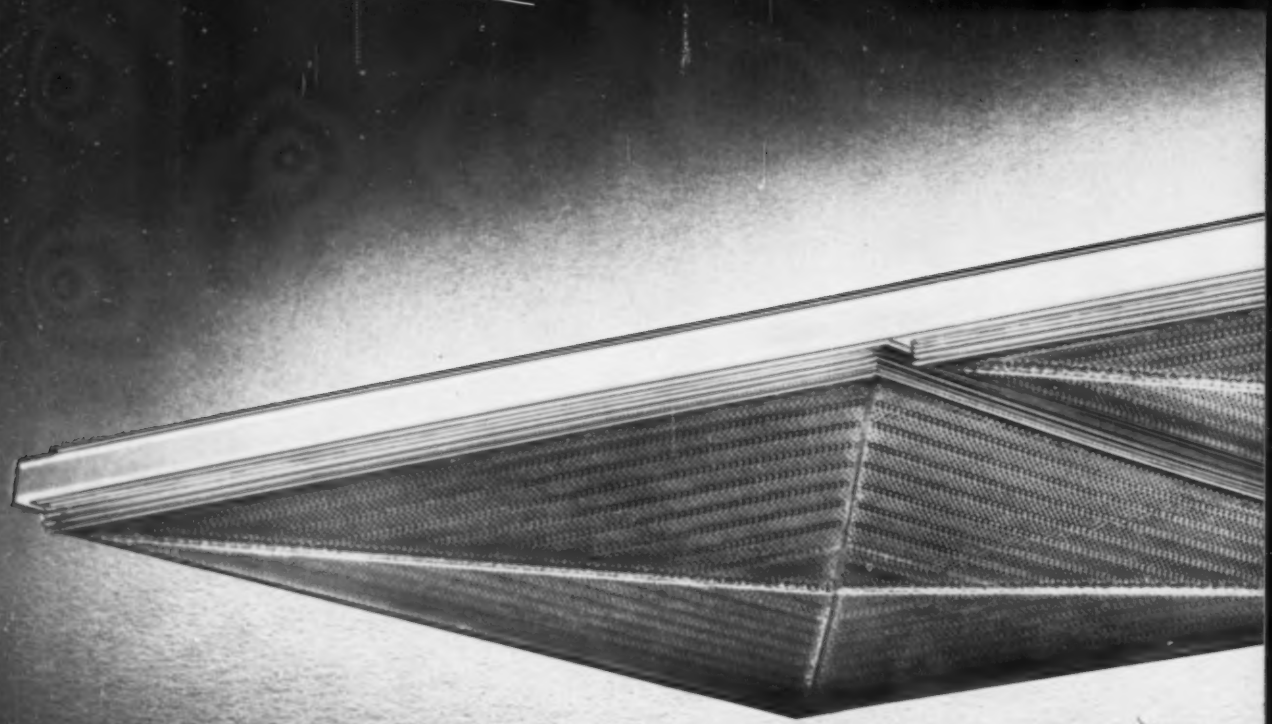

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PRESIDENT'S REPORT

by Richard G. Slauer
President, 1960-1961

It is with mixed emotions that I approach this particular assignment—my last official message to the Society. Over the years, I have had the responsibility of bringing to you many ideas, messages and reports. All of them had one thing in common which made them relatively easy. It was always possible to work into them a promissory note of future participation, future action. This message must be different; its record of stewardship is an act of finality for myself even though it is phrased to challenge your excellent new officers and all members alike.

The Illuminating Engineering Society is a splendid organization; I am proud to have been its president during the past year. Its 10,000 members attest to the need for such a Society; the continuous support of its many programs by individuals and companies shows that we are providing an opportunity; the results of our work prove the service we are rendering to the public. The concentration of membership in Canada and the United States obviously results in having the Society's efforts coordinated primarily with the needs of these two countries; nevertheless our work is of interest and assistance to people everywhere.

A real accomplishment during this past year was the establishment of a sound basis for a continuing program of research. As most of you know, the Society established the Illuminating Engineering Research Institute 17 years ago and has provided, through the Society itself, its individual members, and its sustaining members, almost all of its finances and leadership during this period. But this has been on an informal and short-term planning basis —certainly not a sound approach to our hopes of what research can produce. We have now taken on the obligation of assuring IERI of a major sum of money each year, a sum sufficient for the steady approach needed to many long-term investigations. And because this obligation is an important part of Society financing, we have been assured by the IERI Trustees of their willingness and interest in

Substance of an address by the President at the Opening Session of the National Technical Conference of the Illuminating Engineering Society, September 25, 1961, St. Louis, Mo.

Artist's conception of facade of United Engineering Center. New IES Headquarters are on the ninth floor of the building.

coordinating plans, programs and reports for mutually effective results.

While there are many aspects of this accomplishment, one deserves special recognition here. This is the splendid support by our sustaining members who, in a tremendous show of cooperation, voluntarily raised their dues so that the Society could approach the financing considerations of research without inadvisable sacrifices of other objectives.

A second noteworthy step in the past year was our move to the United Engineering Center in August. We will have facilities for our Headquarters Staff that should provide maximum effectiveness in its discharge of Society work. But even more important should be the recognition and acceptance—by our own membership as well as other scientific and engineering groups—that we are a group of technical workers whose dedication to professional concepts and goals is among the highest. While we are not as large as many others at UEC, our concentration of technical purpose in the single field of lighting makes us a leader in this new Center.

For a third item, I would like to call your attention to our progress in the field of public relations. Good public relations needs a planned program and the means of implementing such a program. Such implementation requires professional skill and manpower. We have made these available to our Public Relations and Information Committee and, through them, to our Society as a whole.

It is so easy to get into semantics when public relations are discussed that I hesitate to introduce further detail. Yet what seems obvious to me may not be obvious to others. The Society does not need publicity on the front page of a newspaper; it needs an acceptance of its goals and standards so that these goals and standards may be of greater help to those for whom they are intended. We must establish an image of the Society which says who we are and what we are doing. Publicity is of value only if it constructively establishes the image of the Society and a picture of the work the Society is doing. It would be wonderful if the entire public could be made cognizant of this. However, the entire public may be too large a goal. It might be quite acceptable if those involved in highway safety, those involved in providing educational facilities and those who establish the environment for work performance in our factories and offices knew of our work.

Many other items of progress could be discussed, but these three are significant because of their effect on our over-all work. To the many diligent members on our committees and in our sections and chapters, I apologize for not specifically listing their work. In the truest sense, there is no insignificant work in the Society—each individual effort has its part in the total structure of progress.

It is inevitable that the intimate knowledge gained by a president in his work with every phase of Society activity discloses certain weaknesses, certain places where improvements and changes would be of value. Unfortunately it is not always easy to suggest the method and details of such

changes; in some cases it is conceivable that improvement might be impossible without introducing adverse conditions elsewhere.

I have examined this approach carefully with the resulting personal conviction that the Society is surprisingly sound in its organization and activities. Certain changes should be considered but these are more related to changes within the profession, the industry, and life as a whole than because they suggest errors in the past.

One hears constantly a reference to "too many meetings." I doubt that this is true. Our job of "advancement . . . of illuminating engineering" and "dissemination of knowledge . . ." is so tremendous that it is inconceivable to me that 10,000 people can do too much in their efforts for almost 200 million. But I do feel that we may need better planning for our meetings; that only meetings that fail to accomplish worthy objectives are ever classed in the "too many" group. Are regular section/chapter meetings planned for specific results or merely to fill a "second Tuesday of the month" schedule? Do we distinguish between meetings where we speak to and among ourselves and those in which we speak to the public? In fact, do we regularly plan meetings for the public and work toward this end? My definition of public is not just anybody; at one time, it might be school administrators; at another, traffic officials. I am merely trying to differentiate between ourselves and everyone else whom we serve.

This is not only a problem for each local board of managers; it is something your officers and Council must consider in relation to regional conferences and our National Technical Conference. I believe much can be done to see that all of our meetings have improved objectives and coordinated consideration. And, as a final thought, let's make sure we don't measure the effectiveness of our meetings merely by counting those who come. Attendance is important, but it is not the only criterion of a good meeting.

In recent years, it has been noticeable that individuals believe they are less free to give their time to committees, to becoming officers, to furthering Society work in many little and some big ways. The usual explanation relates to work pressure, to curtailed traveling, to diversity of interest. I believe this is inevitable as I see our business pattern of today develop, but I don't think its adverse results need be inevitable. One aspect relates to the understanding that a professional engineering society is a society of individuals. It is not a trade organization, a community of corporations. There must be a personal sacrifice, a willingness to infringe on one's own time to improve the prestige, the leadership, the contribution of the Society that represents your chosen work. I am glad that over the years I have contributed my time, but quite pleased to report that if any sacrifice existed, it was more than balanced by the satisfaction of results in the field of lighting and among the fine people of this industry.

One answer, I believe, will be in the form of a larger Headquarters Staff. In effect, we have done this with public relations this year. I believe we need expanded technical work; we could use, effectively, a field man to help the development of sections and chapters. There is obviously a question of money, but I believe this problem is of lesser importance than the one of attitude. As an organization of individual members, we must recognize that all responsibility and direction must emanate from us. We, as members, may require additional assistance to carry out our plans but the continued stature and leadership of the Society must come from what we contribute of our time, interest and experience. We *are* the Society as long as *we* keep it that way. One cannot delegate professional stature, technical leadership or industry effectiveness.

During the past year, our membership increased only slightly. We are still a few short of our goal of 10,000 members. I believe this is a reflection of changes in the lighting industry rather than any lack of interest in our objectives or lack of confidence in what we are doing. Nevertheless it is something that all officers, national and local, must recognize. Growth provides the impetus to greater accomplishments; growth assures the challenge of new thinking to old; growth inherently creates pressure for a pioneering approach to performance. I urge that all of us work toward an atmosphere where growth is inevitable rather than toward one in which lack of growth is accepted as a fact of life and appropriate compensations made. Compensations could become a dangerous opiate for progress.

I would like to direct my final remarks to two items which are certainly not new. Both were summarized just a year ago at the Pittsburgh Conference; both have been presented at meetings over the past 10 years; both have been the basis of my presidential remarks at the regional conferences during the spring months. I appreciate the honor you have expressed by making me your president; I regret my apparent failure to persuade you of these convictions. One relates to the fact that leadership must be earned and not taken for granted; the other that the Society is an *engineering* society and that we should be the last to ignore the implications of this description.

I believe the Society can and should supply the

leadership needed in lighting. But a careful examination of our record over the past few years shows that there are many places in which we have failed. It is less a question of doing wrong than of not doing what a leader must do. Leadership does not necessarily come by following our own pace; someone else may break into new ground because we did not think this new ground was worthy of the effort or possibly because we did not think the time was ripe. This has happened in the outer-space efforts of Russia and the United States. Despite the real accomplishments of United States astronauts and all those associated with the program, it will take a miracle for the United States to become the acknowledged space leader during the next decade. And it isn't sound planning to depend upon miracles!

Directly related to this is my continued emphasis that our Society is an engineering society, that we cannot assume that the results of scientific research and commercial progress absolve us from the responsibilities of engineering examination and engineering appraisal.

Three-and-a-half years ago we were first thrilled by the disclosures of the Blackwell researches, but we have done little to apply the benefits of engineering leadership to the facts as disclosed. Dr. Blackwell attempted to do so in his field factor; it was a guide and nothing more. It was his challenge to us. We did not accept it. The engineer not the scientist is responsible for converting the facts of research into the everyday tools of technology. We cannot lean on Dr. Blackwell or IERI for every answer; we must take specific steps to provide our own answers as engineers. For example:

(1) Shouldn't we take the facts available from IERI and from engineering experience and develop a broad pattern of field factors directly related to each lighting need?

(2) Isn't it up to the engineer to weigh each phase of a lighting problem so that the final recommendation is not related solely to visual performance but includes economics, motivation, environmental adaptation, comfort, and *all* the things we know lead to a preferred illumination level?

(3) Isn't it our job to duplicate Dr. Blackwell's laboratory work with the field work by which every scientific advancement, including nuclear developments, must be tested? After three-and-a-half years not a single engineer of the Society has made and reported a verification of the laboratory results under engineered conditions.

I feel that we have been too complacent, so certain that Dr. Blackwell is right that we have taken many things for granted. President Reid three years ago editorialized, "Now We Know." But do we ever really have a final answer? Isn't there always something more? It is necessary that we supply full attention and leadership to the engineering work of the Society to parallel the continuing research work of IERI.

One may not need world leadership to sustain his own interest and determination, but a failure to achieve it always should provide a basis for self-appraisal. The British have recently established new lighting standards. In so doing they considered the Blackwell report and rejected it as a basis for their standards. To me it is a reasonable assumption that the rejection was less related to the researches of Dr. Blackwell than to the engineering failure to develop his work into practice.

Leadership is not the result of a few lucky happenings. It is earned only by the continuing application of good thinking, effective planning and positive action. I urge that you always make certain the Society, as an engineering society, live up to this pattern in engineering matters.

We must recognize the importance of intellectual maturity. Most of us are convinced of the correctness of our goals. But such correctness does not give us the right to imply facts that are not facts, to magnify bits of information far beyond their original context and scope. In a way we must have the maturity of a judge in court. His personal convictions of innocence or guilt must be subordinated to the due processes of law. Occasionally the rights of the majority are thwarted, the guilty go unpunished; but in the long years of human development, mature thinking assures human progress.

Have I overemphasized "engineering" as related to "research"? I am sure I have not! I am proud to be classed as an engineer. I have no regrets because I am not a scientist. Dr. Julius Stratton, president of MIT, said recently, "It is no longer a question of scientific advances—they will come—but of learning to use them, control them, fit them safely into life in an increasingly crowded and hazardous world, which is the province of engineering." An engineer must deal with the problems exposed by a scientist's facts; he must *apply* science. If the Illuminating Engineering Society is to have the professional prestige it deserves to have, it must recognize its professional obligations. Spending money for scientific research doesn't do this, although it is a splendid start. Moving to UEC establishes an environment, but nothing more. Creating a Society image through public relations is sound only if the image is worth creating.

I feel there is much to do! I challenge your new officers, your new Council, and you, the membership, to make your Society something of which to be proud. It can be done by engineering leadership.

REPORT OF THE PRESIDENT-ELECT

by James R. Chambers
President, 1961-1962

A REPORT by the vice-president is unique in that it affords the opportunity to bring to the attention of all of our members two important aspects of the Society's work. These are: first, the technical progress made during the past Society year; and second, my aims as your elected president during the coming fiscal year, 1961-1962.

Technical Progress

Overseeing the technical operations of the Illuminating Engineering Society is a privilege and a rare opportunity. As you know, this is the responsibility traditionally assigned to the senior vice-president during his term of office. My own experience in it has left me with a profound respect for the dedicated men and women who carry on the Society's technical work.

It is not at all unusual for a technical committee to meet throughout an entire day, and frequently two days. Personnel on some of these committees include names from other professions and other Societies whose time, if purchased, would exceed a respectable portion of our budget. Yet for all of the thousands and thousand of man-hours devoted to technical committee work, not one person receives one penny in compensation. I am sure you can understand when I express my admiration for these unselfish engineers, members and others, and join me in the Society's expression of appreciation for their time and talent.

It may seem, sometimes, that our technical progress is slow. Let me assure you, however, that each passing year builds a stronger foundation for a sound Society structure. This year saw still further growth. Largely as a result of this steady progress in the Society's technical work, entirely new and different visual environments are now in development throughout the United States and Canada.

Let us take a look at some of the progress made this past year.

Out of the research work of Dr. H. R. Blackwell and his staff has emanated the Visual Task Evaluator. This is described in the abstract of the paper on page 543. Many of our task committees have long awaited this field instrument. During this past year, Dr. Blackwell and his staff have used this new instrument to make measurements of seeing tasks for several committees.

Out of this research we have obtained an important tool to help us evaluate, more accurately, everyday visual tasks. This work, and other studies now underway by the Illuminating Engineering Research Institute continue to bring the results of research into application engineering as aids to our many technical committees.

This year, and for the first time, the IES senior vice-president served as a member of the IERI Research Executive Committee. This new and jointly agreed upon procedure more closely integrates basic research with the needs of the Illuminating Engineering Society.

Technical Committee Reports

Current status of technical committee work undertaken this past year is summarized in the accompanying tabulation. You will note that five major technical committee reports were published during the year. Five more have been approved

Substance of an address by the President-Elect at the Opening Session of the National Technical Conference of the Illuminating Engineering Society, September 25, 1961, St. Louis, Mo.

by Council, and are now in final preparation leading to publication.

Of particular interest on this list is the Guide to School Lighting. This has been completed and approved by Council. It must now go to the School Sectional Committee of the American Standards Association, representing all organizations concerned with school lighting. It will be submitted for their approval as an American Standard sponsored by the Illuminating Engineering Society, the American Institute of Architects, and the National Council on Schoolhouse Construction.

In its published form, which we expect to see within a few months, the School Lighting Guide will be a nontechnical document, easily understood and easily used by anyone concerned with the problems of school lighting. The joint AIA, NCSC and IES Committee on School Lighting has done an excellent job in developing its contents and in presenting this material for maximum usefulness. It is expected to be particularly helpful to school board members, administrators and educators, as well as trained architects and engineers designing lighting systems. Chairman John M. Chorlton is to be highly commended for the coordination of the many aspects related to the preparation of this Guide. The Society also acknowledges the contributions of the Technical Director, C. L. Crouch, and his engineering assistant, John E. Kaufman.

The Year 1961-1962

As your president-elect, I would like to report to you a brief digest of my attitudes, aims and objectives for the coming year.

The Illuminating Engineering Society has, as its chief responsibility, the advancement of the science of illumination. Each new president must clearly realize that an engineering society, like a corporation, must support a well-balanced research program or it will soon find itself with an obsolete product. Today, an industry can thrive only by adapting itself to new discoveries, by adapting new discoveries to its use and by making new discovries itself. You and I, who are members of industry, know only too well that this is true. The industry that continues to sell the same old product year after year may very soon find that research in other related fields will consume his market.

During the coming year, I will concern myself to a major degree with four basic interests of our Society. These will be properly interrelated to form a program of Society advancement:

(1) Support of basic research.

(2) The technical members of our Society.

(3) The application engineering membership of our Society.

(4) Public relations and education.

It is through the effective use of these four So-

Technical Committee Reports, 1960-1961

Published

Lighting . . . Keyed to Today's Homes
Questions and Answers on Light Sources (2)
Renaissance in Lighting (Progress Report)
Current Recommended Practice for Sports Lighting
IES Guide for Measurement of Photometric Brightness (Luminance)
Lighting Fundamentals Course

Council Approved—To Be Published

Church Lighting
How to Make a Lighting Survey
Guide for School Lighting
Recommended Practice for Daylighting
Nomenclature (Ultraviolet Radiation)
Nomenclature (Light and Vision Terms)

Submitted to Council

Guide on Color and the Use of Color by the Illuminating Engineer
Lighting of Railroad Classification Yards
Lighting for the Manufacturing of Men's Clothing

Active (Partial Listing)

Careers in Lighting
Advanced Lighting Design Problems Course
Lighting of Piers
American Standard Practice for Industrial Lighting
Lighting for the Rubber Industry
Hospital Lighting
Farm Lighting
Design of Light Control (Part III)
The Effects of Drafts and Temperature on Starting, Light Output and Color of Fluorescent Lamps
Color Rendering
Motor Vehicle (Exterior) Lighting
Progress Report, 1960-1961
Lighting for the Vidicon Camera
Lighting for Educational and Community Theatre Stages
Recommended Practice for Television Lighting
Lighting in the Printing Industry
Store Lighting Guide
Recommended Practice for Roadway Lighting
Guide for Photometric and Electrical Measurements and Life Testing of Incandescent Lamps
Guide for Photometric Testing of Indoor Fluorescent Luminaires
Guide for Electrical and Photometric Measurements of Fluorescent Lamps
Guide for Methods and Techniques of Measuring and Reporting Tests of Reflector Type Lamps
Practical Guide to Photometry

ciety segments that we will bring the science of illumination to the public. I explain:

Basic Research

The organized basic research program of the Illuminating Engineering Research Institute must continue. Necessary funds must be budgeted so that the research program can proceed at an even and uninterrupted pace, for it is only upon the results of this program that the Society will prosper and attain its fullest stature. We must not, for any extended period of time, pause and reflect in the glory of our current research findings.

Technical Membership

Within the technical membership segment of our Society lies the next important portion of this program. Basic research must be interpreted into engineering principles. This is the job of the engineer, and the researcher himself should not be hampered with its solution. Our technical membership should be mobilized to interpret and develop research findings into general application principles for field use. This work is now headed by the Committee on Recommended Quantity and Quality. The size of this operation and the speed with which it will work is related to the productivity of the basic research program.

The engineering conclusions and interpretations of this group will then be made available to a third segment of the program.

Application Engineering Membership

Many of our technical committees today consist of this important segment of our Society. They await the research interpretations and evaluations in order to apply the proper engineering principles to the field of application of their particular committee. The engineering facts handed to them by the "technical membership" will form the guides and practices of the Illuminating Engineering Society. This, then, is an end-product to be turned over to all members for them to put into the everyday practice of illuminating engineering.

Public Relations and Education

The final step is, perhaps, the most difficult. It includes the education of our entire membership as well as the membership of other professional societies on the importance of using these Illuminating Engineering Society guides and practices. Good selling is a result of educating a prospective customer on the usefulness and benefits of the product. A good public-relations program includes education of the prospective user with respect to the service and benefits of the Illuminating Engineering Society and its "products." It will not be enough to mail an IES Recommended Practice to the inquiring user, and assume he understands the science and art of illumination. It just is not that simple. We must *show* the user how the concepts of proper lighting improve environment, improve morale, increase productivity and, in general, upgrade the standards of his specific interest. This can only be done through an extensive public-relations program. We dare not assume that he will understand the benefits, for such assumptions are not well founded and they hold back the acceptance of the concepts of illuminating engineering. I would propose, for example, that the National Parent-Teachers' Association be given the name of every section and chapter chairman. This man would then arrange to provide a speaker on the interpretation of the Illuminating Engineering Society's "Guide for School Lighting" and its benefits to the student.

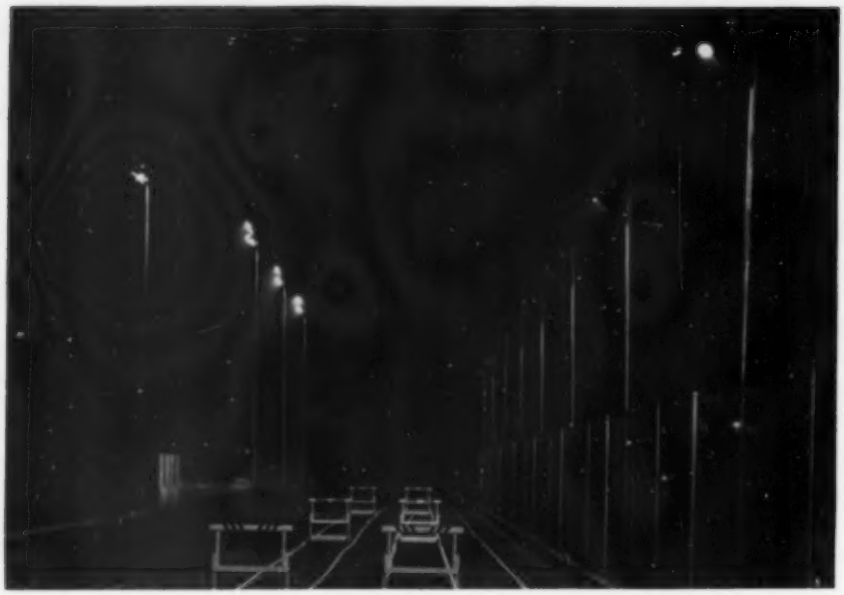
Our presently employed public-relations firm, Raymond C. Mayer Associates, and the IES Committee on Public Relations and Information have submitted to Council an excellent program commensurate with the fulfillment of this fourth step in the over-all program. Coordination of this entire program lies in the hands of Council, the Managing Director and all of the senior staff.

What I have just discussed differs only in emphasis from our present procedures. Currently, researchers have been diverted from their real work in order to provide badly needed field studies. Thus, there has been a delay in basic information output. Our technical membership's progress in the production of engineering data has been impeded by the premature interpretation of research findings. Application committees have, in some cases, grasped at research findings before they have been properly interpreted. Each such well-meant but premature action hinders the progress of the other segments of the program.

Your previous Presidents and Councils have been astute in setting up an organization which exercises proper control. When these organizational channels are followed, progress continues.

The officers, Council and members of the Illuminating Engineering Society are adequately represented within the organization of the Illuminating Engineering Research Institute; the IERI will report to each Council to produce further coordination. Your officers, Managing Director and Technical Director coordinate scope and approval of all Illuminating Engineering Society committee activity. It is within this framework that the science and art of illumination will progress. Harmony is a product of sound organization.

I know I speak for all your elected officers and Council members when we pledge to you our persistent effort to bring you another successful year.



INSTALLATION AT COLTON AVE. ATHLETIC FIELD
UNIVERSITY OF REDLANDS, REDLANDS, CALIF.

Lighting for Track

LIGHTING OBJECTIVE: To provide illumination with a minimum of glare for nighttime sprints and high- and low-hurdle track events.

GENERAL INFORMATION: The straightaway track portion shown above is approximately 42 feet wide and 260 feet long. Each of the five lanes shown is about 3 feet 6 inches wide.

INSTALLATION: Lighting of the five lanes is provided by 11 Revere catalog No. 3823 elliptical shaped class OI, type 6 floodlights, each equipped with one 750-watt PS-52 incandescent lamp and an inner etched Alzak aluminum reflector. These units are mounted atop an 11-foot, 2-inch diameter steel pipe, which in turn is mounted on every fourth 8-foot steel pipe fence support (at right in photo above). Therefore, each unit is 19 feet above grade and on 24-foot spacing.

To minimize glare for the runners, the floodlights are turned 45 degrees toward the direction of travel. The resulting level of illumination is 12 footcandles in the first lane, six footcandles in the center lane and four footcandles in the outside lane.

Luminaires shown at the left in the above photograph are used to floodlight a combination football-baseball field.

Lighting designed by C. M. Pepper, Southern California Edison Co., Redlands, Calif.

Lighting data submitted by C. M. Pepper as an illustration of good lighting practice and to aid in the design of similar installations.

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Series XXVI
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ABSTRACTS 1961

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1. C. M. Cutler & W. C. Martyny: Design and Application of Panel Type Fluorescent Lamps (D. E. Dunne)
2. J. C. Devol: Operating Characteristics, Environmental Testing and Circuit Application of Plastic Electroluminescent Lamps (D. E. Dunne)
3. L. Thorington & J. Shurgan: Fluorescent Lamps of Helicoidal Configuration (D. E. Dunne)
5. G. A. Horton & W. S. Till: Stroboscopic Effect of Mercury Lamps with Various Ballasts and Circuits (E. H. Church)
6. J. E. Rubin & P. F. Dietz: Design of Large Scale Electroluminescent Panel Lighting Systems (M. Buzan)
9. J. Johnson: Zero-Length Searchlight Photometry System (A. R. Chick)
10. D. Dunlop & D. M. Finch: Photometry of Fluorescent Luminaires, Rotating Photocell Method (A. R. Chick)
11. S. M. Segal & S. B. Gibson: Searchlight Beam Spreads from Horizontally Elongated Sources (A. R. Chick)
12. R. J. Smith & W. C. Matz: Modified Current Wave Shape and Starting Voltage Limits for Mercury Lamps (A. W. Weeks)
13. M. A. Chernin: Improvements in Deluxe Fluorescent Colors with New Phosphors (A. W. Weeks)
14. L. G. Leighton: Characteristics of Ribbon Filament Lamps (A. W. Weeks)
15. W. E. Thouret & H. S. Strauss: New Designs Demonstrate Versatility of Xenon High-Pressure Lamps (A. W. Weeks)
16. O. E. Lienhard & J. A. McInally: New Compact Arc Lamps of High Power and High Brightness (A. W. Weeks)
19. C. L. Toomey & J. F. Waymouth: Thermionic Emission of Fluorescent Lamp Cathodes (A. W. Weeks)
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21. A. Lurkis: Combating Juvenile Delinquency with Light (C. Lewis)
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48. D. D. Sullivan: New Approach to Four-Way Luminaire Design (D. R. Brown)
49. H. A. Van Dusen, Jr. & E. F. Schraith: Outdoor Fluorescent Luminaire with Optimum Light Output Over a Wide Temperature Range (D. R. Brown)
50. H. R. Blackwell: A General Method of Computing Reflected Glare and Evaluating Its Visual Significance (K. Franck)

I. RESEARCH

25 Further Appraisals of Luminaire Brightness

Willard Allphin

A PREVIOUS paper[1] reported the results of appraisals by 109 inexperienced observers who adjusted luminaire brightnesses to BCD, the borderline between comfort and discomfort, in a simulated office. It was concluded that BCD is a meaningful concept to most inexperienced observers, and that they could make consistent and repeatable evaluations of it. Data were offered by which proposed methods of predicting discomfort glare can be checked.

Three more series of appraisals have been made in order to answer questions raised by the original work. *Series II* provided two new situations, for the benefit of those who are particularly concerned with how to add glare sources in a formula. Three of the earlier situations were repeated in order to furnish checkpoints. *Series III* asked two questions: Is it permissible to average the brightnesses toward the eye from a nonuniform luminaire which is off the line of sight? Is it necessary to consider the brightness of the ceiling near the luminaire when devising a formula for discomfort glare—again for luminaires off the line of sight? In *Series IV*, prismatic lens shielding was substituted for the plastic in two rows and the luminaires were rotated to face downward.

Fig. 1 shows the simulated office as arranged for Series IV. Ten experienced observers were used, and each observer made five appraisals of five situations in each series.

Fig. 2 shows the results of translating median BCD values into Guth's Indices of Sensation, M_c, and Harrison-Meaker glare factors, G, for Series I (the previous project) and Series II. Actual values for Situations 7 and 8 were lower because observers chose lower BCD's as they became more experienced. However, repeat runs of earlier situa-

AUTHOR: Sylvania Lighting Products, Salem, Mass.

Figure 1. Arrangement for Series IV. Near row and middle row rotated to face downward and equipped with prismatic lenses.

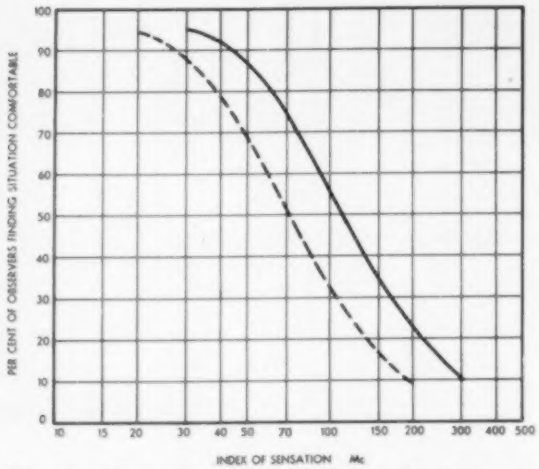


Figure 3. Per cent of observers finding situation comfortable vs Index of Sensation. Solid line, inexperienced observers. Dashed line, experienced observers.

tions gave a basis for pro-rating upward to the dashed lines.

Fig. 3 gives the relationship between Index of Sensation and the percentage of a large group who would find a lighting installation comfortable. The solid line represents experienced observers and the dashed line inexperienced observers.

The following are offered as conclusions:

(1) The addition of two situations similar to those of the previous project did not change the conclusions drawn from that project, and the new situations provided two more checkpoints for testing formulas which predict discomfort glare effects from luminaires in individual units and continuous rows.

(2) It is proper to average the brightness of the luminaire toward the eye when the luminaire is off the line of sight.

(3) The brightness of the ceiling should not be considered in glare formulas dealing with luminaires off the line of sight.

(4) The Guth formula for Index of Sensation reliably predicted the results for diffusing luminaires in both projects.

(5) Observers did not respond as consistently to prismatic lens luminaires, but the results are probably not so far out of line as to rule out the possibility of applying the Guth formula.

(6) Curves are presented (Fig. 3) which offer a means of establishing limits for discomfort glare from an installation of individual or continuous row luminaires.

1. Allphin, Willard: "BCD Appraisals of Luminaire Brightness in a Simulated Office," ILLUMINATING ENGINEERING, Vol. LVI, No. 1, p. 31 (January 1961).

(Abstract of IES Conference Paper No. 25)

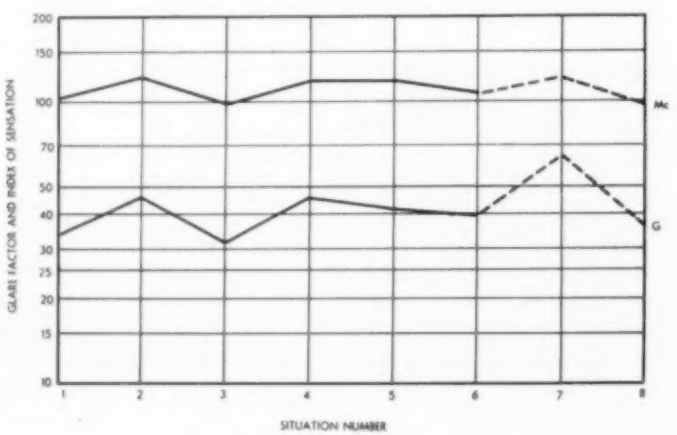


Figure 2. Glare Factors, *G*, and Indices of Sensation, *Mc*, for 50 per cent of observers comfortable. Series II prorated to Series I.

50 General Method of Computing Reflected Glare And Evaluating Its Visual Significance

H. Richard Blackwell

VISUAL performance data reported to the Society in 1958 have provided the basis for newly recommended levels of illumination for various visual tasks, and the growing use of these new levels is undoubtedly providing widespread improvement in visual performance. It must not be forgotten, however, that the performance data were obtained under conditions in which the entire luminous environment was "glare-free," that is, of uniform luminance. It is appropriate that we have now turned our attention to a study of reflected glare, which is one of the visual problems introduced by the presence of nonuniformities in the luminous environment. The present study provides a general method for calculating the physical loss in task contrast due to reflected glare produced by any visual environment of interest and for evaluating the visual significance of the loss in contrast in terms of the illumination increase required to compensate for it. The study reveals that there are various lighting materials and layouts of luminaires which can greatly increase the visual effectiveness of lighting with respect to other common materials and layouts. Thus, it is apparent that design of lighting to reduce reflected glare has a visual significance as great as many of the increases in lighting involved in the new recommended illumination levels.

Computation of the physical loss in contrast of a given visual task is carried out from the equation

$$C = \frac{\Sigma E_H R_H C_H + \Sigma E_V R_V C_V}{\Sigma E_H R_H + \Sigma E_V R_V}$$

where E_H and E_V are illuminations arising from a given point in space with horizontal and vertical polarization vectors;

R_H and R_V are reflectances of the task when illuminated by the given point in space with illumination exclusively of horizontal and vertical polarization vectors respectively; and

C_H and C_V are luminance contrasts of the task detail against the task background when illuminated by the given point in space with illumination exclusively of horizontal and vertical polarization vectors respectively.

The summations are considered to be carried out for all suitable points in space above the task. Obviously, the quantities R_H, R_V, C_H and C_V are characteristics of the task, and the quantities E_H and E_V are characteristics of a luminaire design.

We have obtained complete sets of physical values of R_H, R_V, C_H and C_V from seven visual tasks, including: (a) ink pen on matte paper; (b) mimeo; (c) Thermofax; (d) soft pencil on matte paper; (e) typewriter on matte paper; (f) ballpoint on matte paper; and (g) glossy journal (ILLUMINATING ENGINEERING). We have obtained complete sets of physical data on more than a dozen materials used for light control and diffusion, from which

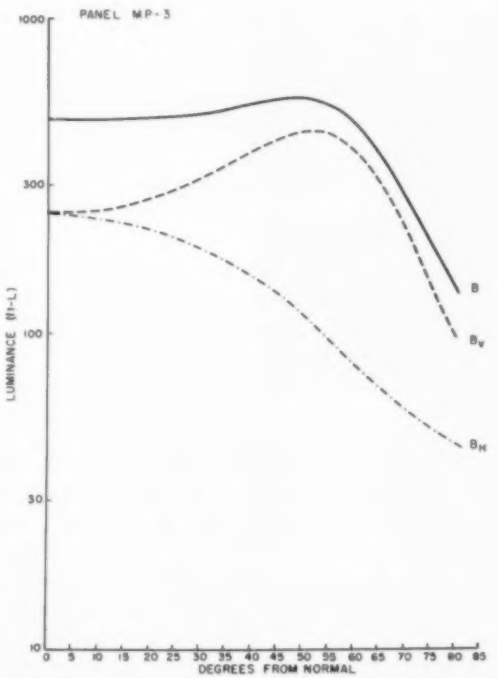


Figure 1. Luminance characteristics of a multi-layer polarizing panel.

AUTHOR: Professor and Director, Institute for Research in Vision, The Ohio State University, Columbus, Ohio. This study was sponsored by The Illuminating Engineering Research Institute as Project #70. The assistance of Benjamin S. Pritchard and Richard N. Schwab is gratefully acknowledged.

values of E_H and E_V may be computed for any hypothetical luminaire layout. These data take the form which is shown in Fig. 1, where B_V and B_H are luminances in vertically and horizontally polarized light.

Calculations reveal that some lighting materials and some lighting layouts more than double the task contrast obtained with other commonly used materials. Such an improvement is as effective as an astronomical increase in illumination level. Taking the average of many visual tasks, some lighting materials and some lighting layouts produce a quality of illumination which makes them as effective as approximately four times the quantity of other commonly used types of illumination. Among the lighting materials, sources of radially symmetrical polarized light were especially effective. Among lighting layouts, the luminous ceiling was especially effective. Luminous ceilings of polarizing materials were more effective than luminous ceilings of nonpolarizing materials or scattered luminaires covered with polarizing materials.

(Abstract of IES Conference Paper No. 50)

24 Visual Studies of Driving In Traffic Routes and on Motorways

J. M. Waldram

STREET LIGHTING is installed in the interests of safety. It is now an established fact that good street lighting brings about a reduction on the order of 30 per cent in personal injury accidents at night, as compared with poor lighting. This is a valuable result, but insufficient for the engineer who has to design lighting and needs to know its important characteristics in much more detail than statistical research can possibly give. Motorways are unlighted in most countries, although some Continental lengths have been lighted, at considerable expense. It is necessary to know whether a real case exists for lighting these motorways, how strong the case is, and, if it does exist, what the characteristics of the lighting should be.

These problems have been studied starting with the thesis that the primary task of street lighting is not to reduce accidents, but to give information to road users. The problem then reduces to two questions: What information do drivers require in different circumstances, and by what means is this information presented to them by day and night? If these questions can be answered, the importance of such features as contrasts, glare, patchiness, color, emphasis, and so forth can be appraised. If the information presented on motorways by headlights alone is compared with the information shown to be needed by the driver, the need for fixed lighting on motorways can be assessed with some degree of certainty.

The method of study employed was to drive in many different situations in a vehicle equipped with a tape recorder on which the driver recorded a commentary on exactly what he was looking at, how he used his eyes, and the information which he was seeking from the scene. This was supported by films taken simultaneously (including night shots by headlights only) and by records of eye movements in another experiment. These studies in different situations on traffic routes and on the motorway established the information required by the driver. In another series the driver recorded comments on how information was presented, *e.g.*, the importance of contrasts, level, mist, color, glare, patchiness, backgrounds, etc. This was supported

AUTHOR: The General Electric Co., Ltd., Central Research Laboratories, Hirst Research Center, Wembley, England.

by studies of daytime conditions, reduced in brightness to night levels, by color photographs and by photometric measurements.

The "mechanism" of driving in empty streets, with light traffic, with heavy traffic and on the motorway was elucidated and new comments on the important features and weaknesses of street lighting emerged. It was concluded that on British motorways there was no severe problem by day. At night, by the light of headlights alone, conditions were not difficult in good weather so long as nothing unexpected occurred. In emergency conditions, however, the information available to the driver was grossly insufficient for enabling him to take the necessary action safely. Fixed lighting could give this information, and it was concluded that there was a technical case for its provision. Its necessary characteristics are laid down. The paper does not discuss the economic or engineering aspects of such lighting.

Figure 1. Test vehicle with camera and microphone.

(Abstract of IES Conference Paper No. 24)

Development of Visual Task Evaluators for Use in Specifying Recommended Illumination Levels

A GENERAL METHOD for specifying the illumination requirements of various visual tasks, reported to the Society in 1958, has provided the basis for the Society's newly recommended lighting levels. The method involved the use of a lighting specification curve based upon extensive visual performance data, and a "Visual Task Evaluator" used to assess the difficulty of any task of interest to obtain an index for use with the lighting specification curve. The Visual Task Evaluator is thus an essential element in the practical use of the method for specifying illumination requirements and, indeed, little practical use can be made of the method without such an instrument.

H. Richard Blackwell

The original Visual Task Evaluator (VTE) was a very complex research device, involving the considerable flexibility required during initial development of a new instrumental concept. Since 1958, this single instrument has been the sole source of the visual assessments needed by the technical committees of the Society to arrive at their working recommendations for lighting levels. Since the existence of a single instrument has tended to hold back the work of the committees, we have attempted to develop a VTE suitable for limited production and general use.

Initial study revealed that various VTE operating principles may be used with equivalent results whenever the visual task is presented in an environment of uniform luminance. However, the results of visual assessment differ markedly, depending

AUTHOR: Professor and Director, Institute for Research in Vision, The Ohio State University, Columbus, Ohio. This study was sponsored by The Illuminating Engineering Research Institute as Project #30. The assistance of Benjamin S. Pritchard and Richard N. Schwab is gratefully acknowledged.

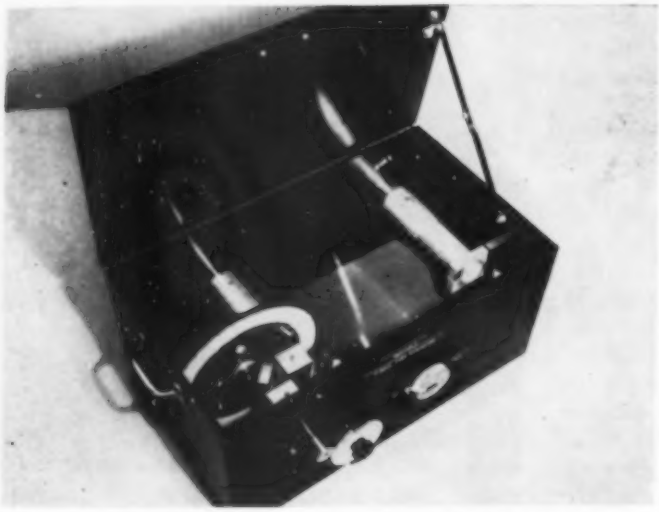


Figure 1. Current model of the Visual Task Evaluator.

upon the operating principle adopted for use, whenever the visual task is presented in a background of nonuniform luminance, such as occurs in the case of street and highway lighting. The correct operating principle was found to require that the relevant element of the task first be identified, and that the assessment index then be expressed in terms of the luminance of the background of the indicated relevant element. This operating principle requires that the VTE contain a telescopic viewing system with variable magnification.

Fig. 1 exhibits our current model of the Visual Task Evaluator which is based upon the indicated operating principle. Details of design, calibration, and operating procedures will be given. Comparisons will be made between the principles underlying this instrument and the principles underlying other instruments which have been developed to assess task visibility and, in some cases, to specify illumination levels.

(Abstract of paper presented at IERI Session)

30 A Mathematical Equivalent To the "Scissors Curve"

John J. Neidhart

Theodore Ake, Jr.

SINCE ITS introduction, the Scissors Curve has been a helpful guide to many lighting designers but has been criticized by some as a "go—no-go" gauge lacking in flexibility and ease of understanding. This paper presents a more easily understood mathematical equivalent to the Scissors Curve that provides greater flexibility and permits simple comparisons of radically different luminaire brightness distributions.

A series of weighting factors was derived by applying the lever arm principle to the standard graphical form of the scissors curve.[1] To prove that the weighting factors thus derived did make all limiting lines of the scissors curve equivalent, the factors were applied to the brightnesses in the tabular form of the scissors curve.[2] The result of this check showed that the sums of the weighted

AUTHORS: The Miller Company, Illuminating Division, Application Engineering Department, Meriden, Conn.

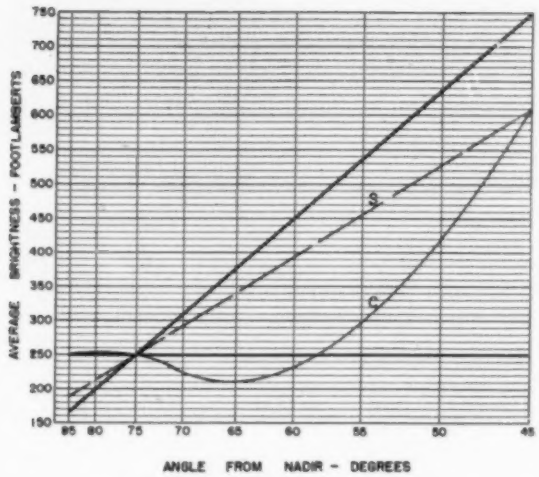


Figure 1. Crosswise (C) brightness distributions for a two-lamp, 40-watt, rapid-start, two-foot-wide troffer with prismatic bottom *vs* scissors curve (S).

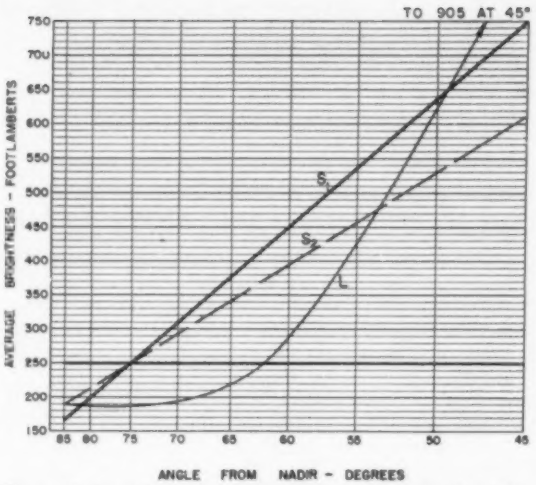


Figure 2. Lengthwise average brightness distribution (L) for three-lamp, 40-watt, two-foot troffer with prismatic glass bottom *vs* scissors curve S_1 or S_2.

brightness values for all columns were essentially equal and the average of the sums was 8555, which thus represents an equivalent to the scissors curve.

The weighting factors for each of the angles of concern are as follows:

$W_{45°}=1.0, W_{55°}=1.75, W_{65°}=3.95, W_{75°}=10, W_{85°}=17.5.$

The term "Brightness Rating (BR)" is suggested to compare the weighted brightness of a luminaire with the scissors curve value of 8555.

$$BR=\frac{B_{45°}+1.75\,B_{55°}+3.95\,B_{65°}+10\,B_{75°}+17.5\,B_{85°}}{8555}$$

B = Average Brightness

Any brightness rating not greater than 1.0 indicates compliance with the scissors curve. Crosswise and Lengthwise Brightness Rating (CBR and LBR) would be provided separately along with the presently-published average brightness data.

The use of brightness ratings will provide a means of evaluating the situations shown in Figs. 1, 2, and 3, where none of the curves shown meet the graphical scissors curve limitations. In Figs. 1 and 2 a question arises as to whether the low brightnesses at some angles can compensate for the excessive brightness at other angles.

In Fig. 1, CBR=1.03 indicates that the excess brightness at 85 degrees is not compensated for; whereas in Fig. 2, LBR=.90 indicates that the low brightness at high angles does compensate for the excess brightness at 45 degrees.

Fig. 3 shows widely differing brightness distributions which can be evaluated by the brightness rating system to determine their relative glare-producing effects. $CBR_A=1.98$ and $CBR_B=2.19$, indicating that Unit A could be viewed crosswise with more comfort than Unit B although neither satisfies the scissors curve requirements.

It is hoped that this simple brightness rating system will be considered by the Office and School Lighting Committees as a possible approved equivalent (not substitute) to the scissors curve.

1. IES Recommended Practice for Office Lighting, 1960, Fig. 4.
2. *Ibid.*, Table II.

(Abstract of IES Conference Paper No. 30)

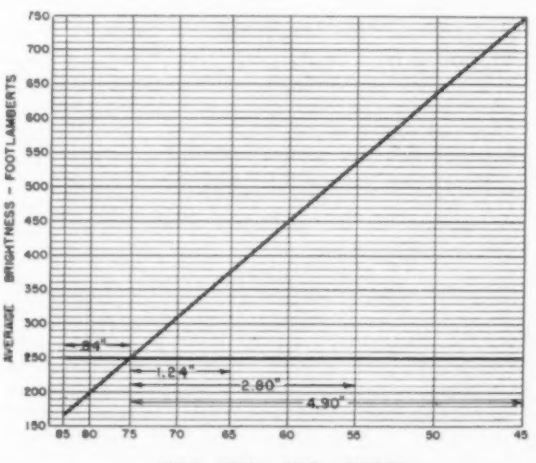


Figure 3. Measurement of lever arms (A) for use in Equation 1.

39 New Light on Visual Threshold Contrast

Nelson W. Taylor

RECIPROCAL threshold contrast $B/\Delta B$ is shown to be a normal probability integral of log B, the adapting luminance. Blackwell data are used. The parameters, median luminance, log B_m, standard deviation σ, maximum slope, and upper limit $(B/\Delta B)_{max.}$, depend, systematically, on target diameter and duration of light stimulus. The characteristic optical density-log exposure curves (D-log$E$) of many photographic films and papers are also probability integrals. It is believed that the similarity between the visual and photographic responses to light arises from a real or effective distribution of sensitivities of the responding elements in each case. Pictures having richest tonal detail are produced when the steepest part of the response curve is utilized. Likewise, evidence is presented to show that the best visual subjective tonal contrast is obtained when the illumination is such as to utilize the steep portion of the $B/\Delta B$-log B response curve. Such levels of illumination are, in most cases, well below those currently recommended in the *IES Lighting Handbook*.

(Abstract of IES Conference Paper No. 39)

AUTHOR: Senior Research Scientist, Duplicating Products Division, Minnesota Mining and Manufacturing Co., St. Paul, Minn.

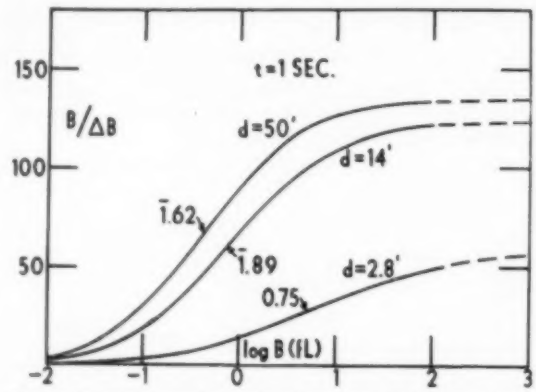


Figure 1. Reciprocal threshold contrast $B/\Delta B$ *vs* adapting luminance log B in footlamberts for three circular targets exposed for 1 second. Target diameters are 50, 14 and 2.8 minutes of subtended angle at the eye. Note inflections at log $B_m = -0.38$, -0.11 and 0.75, respectively. The corresponding asymptotes $(B/\Delta B)_{max.}$ are estimated to be 134, 123 and 57.

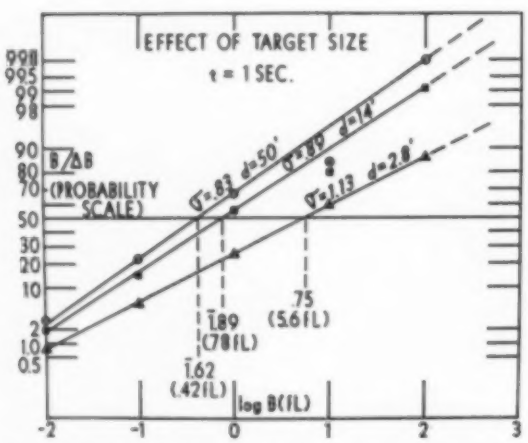
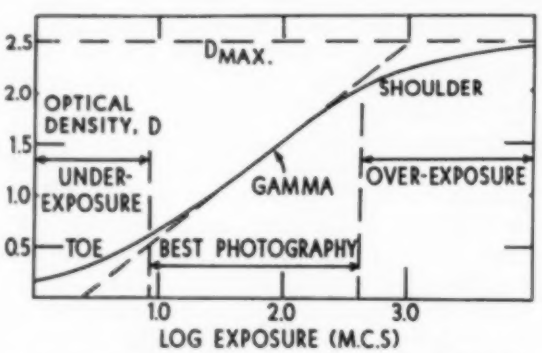


Figure 2. Normalized values of $B/\Delta B$ as ordinates on a gaussian probability grid *vs* log B, using the same data as in Fig. 1. Each ordinate value is a ratio of $B/\Delta B$ to $(B/\Delta B)_{max.}$, expressed as per cent $(B/\Delta B)_{max.}$, obtained by trial so as to yield straight line plots. Adherence of the data to a straight line demonstrates that $B/\Delta B$ is a probability integral which is functionally dependent on log B. Note the effect of target size on the values of the standard deviation σ and the median luminance B_m.



Figur 3. Optical density *vs* log exposure (D-log E) curve for a photographic film. The best rendition of the tonal scale, *i.e.*, of variations in scene luminance, is obtained when the steep "gamma" or approximately linear portion of the D-log E curve is used. "Flat" negatives are obtained if the shoulder or toe is used. Note the similarity in shape to the visual response curves of Fig. 1.

II. ROADWAY & AVIATION LIGHTING

Left to right:

Walter Faktor
Irving Fishman
Henry W. Wenson, Jr.

26 Hangar Lighting at New York International Airport

THE GREATEST variety of hangar lighting installations in the United States is to be found at New York International Airport. This paper reviews a number of these installations, presenting data on cost per square foot, watts per square foot and average maintained illumination level. The installations discussed employ several light sources — incandescent, fluorescent and mercury — both singly and in combination.

AUTHORS: Engineering Department, The Port of New York Authority, New York, N. Y.

The roof design of a hangar has a strong influence on the design of the interior lighting installation. As may be seen from Fig. 1, the hangars at New York International Airport display a variety of hangar designs.

The survey conducted drew attention to a number of lighting problems which should be considered in future hangar lighting design. The size of aircraft has been increasing at a rapid rate. The wings and fuselages of these crafts are high off the hangar floor. This would tend to permit light sources not located directly over the airplanes to penetrate undercarriage areas. In spite of this, however, even where light-colored floors are used, additional lighting is required for work on landing gear and other equipment in similar locations.

Engine areas present a problem of a similar nature. One installation which comes reasonably close to a solution consists of additional fixtures in nosebay areas targeted to provide light at an angle of about 45 degrees on the craft in the engine and nose areas.

Poor maintenance of any installation compromises the ultimate goals the design was intended to achieve. Hangars present a particularly difficult lighting maintenance problem for several reasons. Mounting heights here are much greater than those usually encountered by the illuminating engineer. In addition, the operating airline, in its attempt to make maximum use of hangar space and minimum aircraft down time, may have aircraft moving in and out of hangar areas at frequent intervals. This results in great difficulty in establishing and adhering to lighting maintenance schedules.

An attempt has been made in this paper to present a variety of illumination solutions for a typical group of large hangars. The present trend is away from incandescent lamps. Over-all economy dictates the use of fluorescent and mercury sources in large hangar installations because of higher lumen output per watt and longer life.

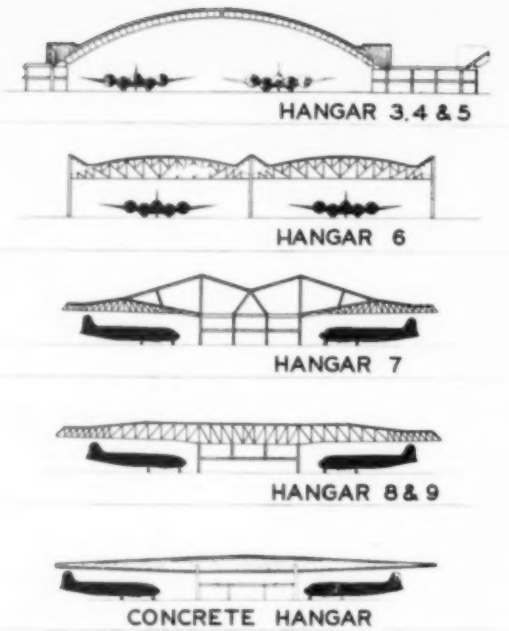


Figure 1. Types of hangar roofs—New York International Airport.

(Abstract of IES Conference Paper No. 26)

29 Aircraft Exterior Lights for Preventing Mid-Air Collisions

WITHIN THE last few years, a need for improved, scientific testing and evaluation of navigation light systems has been recognized and has led to the sponsorship of such programs by government agencies. This paper, which summarizes some of the work done under these programs, is intended not only to present the results of the investigation but to emphasize the methodological approach.

In 1957, the Navy contracted for a comparative evaluation of several exterior lighting systems.[1] The systems were compared in a series of flight problems in which observers were required to find the "intruder" and try to estimate his aspect. The problems were randomly presented to the observers, but each presentation was under full control and the results could be objectively analyzed for search time, decision time, and decision accuracy. The results indicated that no single system was consistently superior to the others in all respects.

AUTHORS: Messrs. Robinson and Cook, Applied Psychology Corp., Arlington, Va., Mr. Projector, Consulting Engineer, Kensington, Md., and Mr. Bartelt, Bureau of Naval Weapons, Navy Dept., Washington, D. C.

J. A. Bartelt

T H. Projector

K. G. Cook

J. E. Robinson, Jr.

In 1958, the (then) Airways Modernization Board contracted for an analysis of the state of the art in aircraft exterior lighting systems.[2] The analysis strongly recommended a systematic investigation of the problem with emphasis on objective methods and the need for regulatory standardization.

In 1959, the Bureau of Research and Development of the Federal Aviation Agency contracted for such a comprehensive program, and included in it all aspects of visual collision avoidance, for both day and night operations. In the course of carrying out this program, a visibility test range has been constructed near the Federal Aviation Agency Test Center at Atlantic City, N. J. The range is being used for ground-to-ground and ground-to-air field tests. Demonstration equipment has been constructed to illustrate some of the important problems of day and night collision avoidance. In the night part of the exhibit, 19 navigation light systems are displayed on six model aircraft. This exhibit illustrates the variety of systems that have been proposed as well as the signal ambiguities that occur when a number of them occupy the same airspace.

Analysis of the information requirements for collision avoidance, carried out under the program, indicates that azimuthal sector coding, common to almost all systems, is of much less usefulness than has been supposed.[3] An experimental program, conducted in a flight simulator, bears this out.[4] The analysis further shows that of the remaining kinds of information that might be conveyed by navigation lights, only altitude information, altimeter-derived, can substantially improve the pilot's ability to solve the collision avoidance problem.

The Bureau of Naval Weapons, in 1960, contracted for experimental work to determine those flashing light patterns easiest to learn and most accurately identifiable.[5] As a result of the studies conducted under this contract, 11 Morse code signals and six "dot" signals (consisting of patterns of dots only) were recommended as acceptable in operational situations.

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(Abstract of IES Conference Paper No. 29)

28 Lighting of Heliports

Victor E. Converso

THE NEW Downtown Manhattan Heliport shown in Fig. 1 uses yellow fluorescent marker lights installed around the perimeter on 25-foot centers. A large area linear light source was selected for this application because of its better rendition of the horizontal plane and eye comfort for the pilot in the final touchdown stage of the approach to landing. The visual task in VFR helicopter approaches is somewhat different from high-speed, low-angle approaches of fixed-wing aircraft in that, due to the small size of the landing area, steep glide angle and slow approach speed, there appears to be more of a fixation on specific light sources from initial approach to final touchdown as compared to the scanning action that takes place in landing on a long runway at relatively high approach speeds.

The task of floodlighting the helicopter parking and the passenger loading areas was a demanding one. The goal was a glare-free and obstruction-free operational area from a pilot's viewpoint and an above-average footcandle level for passenger convenience and safety.

AUTHOR: Aviation Planning Division, The Port of New York Authority, New York, N. Y.

To satisfy these prerequisites, experiments were conducted with several eight-foot controlled fluorescent reflectance units which were mounted two feet above the ground at the New York International Airport heliport. To eliminate the glare of the reflection of the light source itself, the luminaire was designed with the face canted outward from the top. This unit, reported to be relatively glare-free, by New York airways pilots, was installed on 25-foot centers. These units are interspersed with the yellow marker lights on both sides of the pier with the exception of the outer 80 feet which are critical from an obstruction standpoint. This critical area was respected by a design installation detail requiring the marker lights to be completely recessed in the wooden string piece which borders the heliport.

The light distribution of the floodlights is shown in Fig. 2. As can be seen from this curve, the midpoint of the pier has 3.5 footcandles, and the lighting level increases to approximately 18 footcandles at a point 20 feet in from each side of the pier. At a point 10 feet in from the edge, there are approximately 55 footcandles. This high level of illumination at the pier edges is very desirable from a safety viewpoint, since the west side of the pier serves as a passenger walkway and helicopters taxiing to and from the landing and take-off area will have their outboard landing gear approximately five feet inboard of the pier edges when following the taxiway centerline. The need for an above average footcandle level along the pier edges is therefore self-evident. The resultant effect is shown in Fig. 3, a nighttime aerial photograph of the heliport.

(Abstract of IES Conference Paper No. 28)

Figure 1. Port-Authority Downtown Heliport in Manhattan.

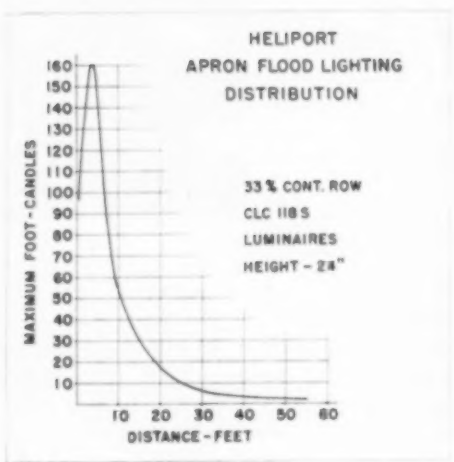

Figure 2.

Figure 3. Aerial view of Downtown Heliport at night.

42 Light Distributions for Effective Control of Glare in Roadway Lighting

R. L. Kaercher

A. W. Fowle

REDUCTION of "glare" in street lighting, long recognized as a major problem, can produce significant benefits in improving visibility and increasing comfort. In many cases as much as 30 per cent of the street lighting dollar is wasted due to "visibility reducing" glare.

Of the two possible forms of glare that occur simultaneously within the human eye, the only one that interferes with the ability to see is that due to disability veiling brightness. The discomfort glare condition has no effect on the ability to see and should be considered as secondary as far as the cost of light and effectiveness of a roadway lighting system are concerned. Fortunately, however, any measures taken to reduce disability veiling glare, by reducing light flux at the eye or increasing the angular displacement of the source from the line of sight, will also reduce discomfort glare.

Reduction of both forms of glare using "shielding" type luminaires is standard practice for interior applications but has not been generally adopted for roadways in this country, due to the uneconomical, short spacings required for uniform coverage. Although such luminaires were developed as far back as 50 years ago,[1,2] the increasing

AUTHORS: Holophane Co., Inc., Newark, Ohio.

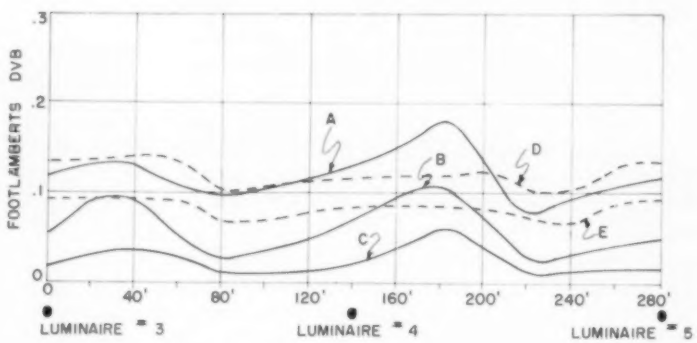

Figure 1. Variation in disability veiling brightness, DVB, for different distributions as driver-observer travels through a typical system.

A—High-angle mercury luminaire, 77 degrees.

B—Medium-angle mercury luminaire, 74 degrees.

C—Low-angle mercury luminaire, 69 degrees.

D — Four-lamp transverse fluorescent, 55 degrees.

E—Two-lamp transverse fluorescent, 67½ degrees.

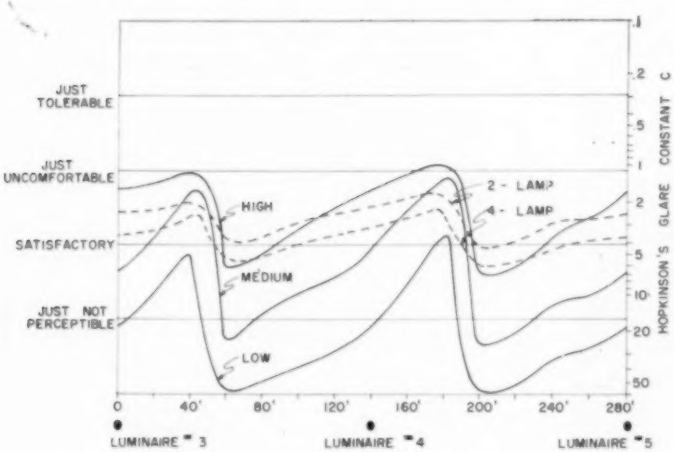

Figure 2. Variation in discomfort glare for different distributions as driver-observer travels through a typical system.

High-angle mercury luminaire, 77 degrees.

Medium-angle mercury luminaire, 74 degrees.

Low-angle mercury luminaire, 69 degrees.

Four-lamp transverse fluorescent, 55 degrees.

Two-lamp transverse fluorescent, 67½ degrees.

practice of (a) using external "glare shields" and (b) lowering the beam angle by shifting the light center position, indicates there is now more than just a passing desire to reduce glare effects in roadway lighting. More precisely controlled, low-angle distributions, which both lower the beam angle and reduce flux in the upper portions of the beam, will contribute greatly to reduction of system glare effects.

Methods of calculating system glare effects for roadway lighting which permit easier and quicker evaluation of different luminaire light distributions have recently been developed.[3, 4] A new short-cut method of obtaining disability veiling glare is described. A new method of using DVB constants permits easier calculation of system DVB for different luminaire distributions, Fig. 1.

Discomfort glare calculations are made using Hopkinson's formula[5] in combination with a glare rating scale developed for roadway lighting by Ruff and Lambert.[6] Results reproduced in Fig. 2 show comparative discomfort glare effects for the same systems. A study of the results from these and other light distributions shows the extent to which discomfort and disability effects are reduced as the beam angle is lowered, and illustrates that proper control of candlepower above beam angle is of major importance in reducing glare.

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(Abstract of IES Conference Paper No. 42)

49 Outdoor Fluorescent Luminaire with Optimum Light Output Over a Wide Temperature Range

Edward F. Schraith

Harold A. Van Dusen, Jr.

FLUORESCENT lamps are temperature sensitive, that is, their light output decreases as the lamp bulb wall cold spot operates at other than its optimum temperature. As a result of this characteristic, the light output of fluorescent lamps operating in outdoor luminaires is lower than their rated value for much of the normal ambient temperature range.

An outdoor fluorescent luminaire having essentially constant light output over a wide temperature range has been introduced. This luminaire uses the principle of "controlled spot cooling" to maintain optimum light ouput at temperatures that would otherwise be too high for efficient light generation. Thermo-electric heat pumps are used to spot cool the fluorescent lamps.

Design critera, theory of operation and operating characteristics of the controlled spot-cooled fluorescent luminaire are discussed. Data presented describe operating parameters of the lamps (such as transient effects, luminous efficiency, etc.) when operated in a controlled spot-cooled luminaire. The amount of spot cooling required to maintain the lamp bulb wall cool spot at optimum

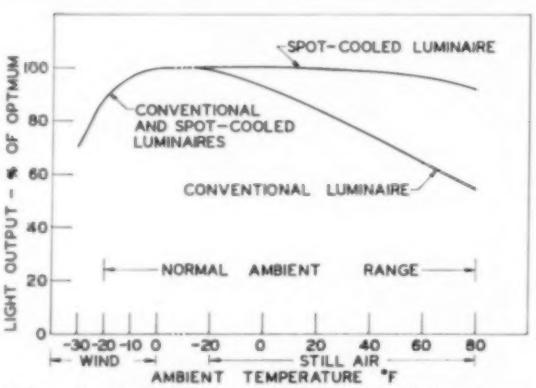


Figure 1. Comparison of similar spot-cooled and conventional fluorescent luminaires.

AUTHORS: Line Material Industries, South Milwaukee, Wis.

temperature is regulated by providing on-off control of the power into the heat pumps by means of a thermostat monitoring the cold spot temperature.

The economics of using controlled spot-cooled fluorescent luminaires are also presented. It is shown that controlled spot cooling of fluorescent luminaires is an effective means of obtaining a greater useful light output without increasing the physical size of the luminaires. Installed and operating costs for an equivalent maintained lighting level can be lower, and the variation in fluorescent luminaire light output caused by ambient conditions can be effectively negated.

(Abstract of IES Conference Paper No. 49)

48 New Approach to Four-Way Luminaire Design

Daryl D. Sullivan

THIS PAPER presents, in detail, the optical design and resultant performance of a new four-way luminaire. To clarify design goals, the paper includes a discussion of the geometry of the intersection lighting problem.

The optical design of the luminaire is unique in that the reflector is *optically round* but *mechanically oval*. The rays striking the reflector are redirected back toward the light source and proceed on to the refractor. At a point P on the refractor, both the direct and reflected components are lined up laterally. Thus, a prism at P is able to refract them equally and into the same lateral direction. The refractor has some nonconventional prisms with varied alignments that combine with the reflector to produce the isofootcandle diagrams shown in Fig. 1a. Fig. 1b is a photograph of the luminaire with the light pattern it produces projected on a white screen. A street intersection, to approximate scale, is superimposed on the pattern to show orientation of light with respect to the curbs.

(Abstract of IES Conference Paper No. 48)

AUTHOR: Technical Products Division, Corning Glass Works, Corning, N. Y.

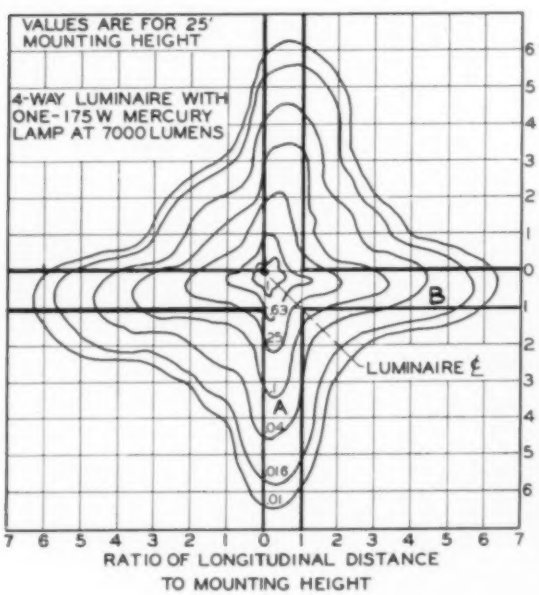
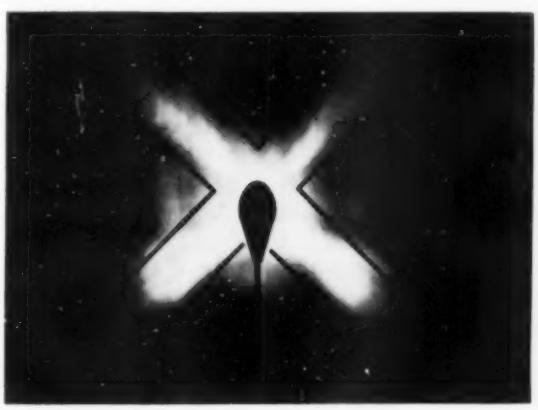

VALUES ARE FOR 25' MOUNTING HEIGHT
4-WAY LUMINAIRE WITH ONE-175 W MERCURY LAMP AT 7000 LUMENS
B
.63
.25
LUMINAIRE ℄
A
.04
.016
.01
6 5 4 3 2 1 0 1 2 3 4 5 6
7 6 5 4 3 2 1 0 1 2 3 4 5 6 7
RATIO OF LONGITUDINAL DISTANCE TO MOUNTING HEIGHT

Figure 1a (left). Isofootcandle diagram.

Figure 1b (below). Light pattern produced by luminaire incorporating the new approach.



III. LIGHT SOURCES

13 Improvements in Deluxe Fluorescent Lamp Colors with New Phosphors

M. A. Chernin

A NEW design choice for fluorescent deluxe lamps has been developed and put into practice. This new design utilizes only two phosphors instead of three or four as is the usual practice in the industry. These two phosphors are strontium-magnesium orthophosphate (tin as the red emitter) and strontium halophosphate (antimony and manganese as the blue-green emitter).

This two-component deluxe system has eliminated or greatly improved three inherent disadvantages of the three-component system. These are: (1) color difference from one end of the lamp to the other; (2) color shift through life; (3) color differences from batch to batch.

In addition, the two-component deluxe system has provided other advantages. Among these are better color rendering, due to the broader spectral emission of the orthophosphate phosphor as compared to the previously used red emitter. Figs. 1 and 2 show this feature for cool white deluxe and warm white lamps, respectively.

Higher luminous efficacy and higher mean lumens are also attained with the two-component deluxe system. These increases are in the order of 11 per cent in efficacy and 14 per cent in mean lumens.

Lower ultraviolet emission and elimination of afterglow are other features of the two-component

AUTHOR: General Electric Co., Nela Park, Cleveland, Ohio.

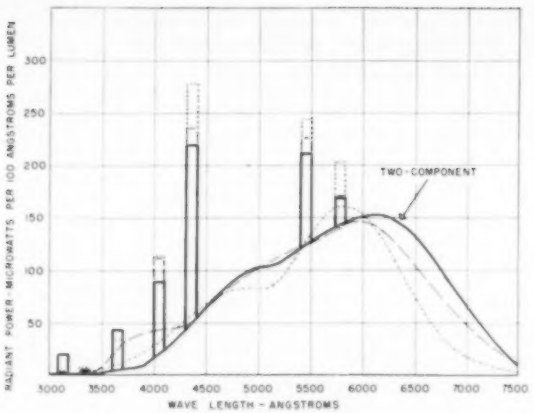


Figure 1. Spectral curve comparing two-component cool white deluxe with typical American cool white deluxe lamps. Curves represent the distribution of one lumen of light.

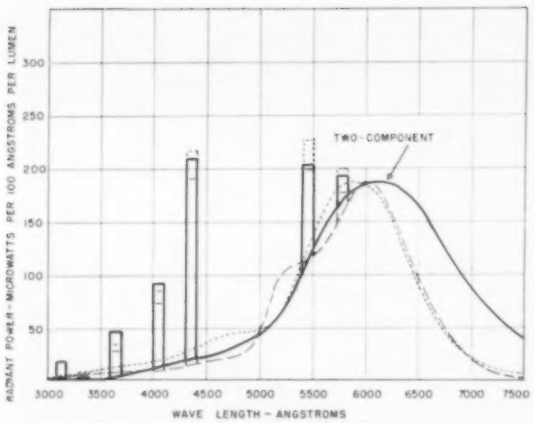


Figure 2. Spectral curve comparing two-component warm white deluxe with typical American warm white deluxe lamps. Curves represent the distribution of one lumen of light.

deluxe system. The deluxe lamps are now similar to the corresponding standard lamp colors in these two aspects. The lower ultraviolet emission should help greatly in reducing the discoloration and deterioration of plastic luminaire parts, fabrics and other objects. The lack of afterglow will not only eliminate an annoyance, but may also be of interest for photographic darkroom applications.

The two-component deluxe system is carried over into the highly loaded fluorescent lamp types also. By adjustments in phosphor chemistry and mixture compositions, highly loaded deluxe lamps can be produced at the same visual color as the 40-watt varieties. The above mentioned advantages of the two-component system carry over to the highly loaded types also.

(Abstract of IES Conference Paper No. 13)

2

Operating Characteristics
Environmental Testing
Circuit Application of

Plastic Electroluminescent Lamps

J. C. Devol

In the past few years a number of different types of electroluminescent lamps have reached the market. These lamps are generally characterized by a rigid glass or metal substratum upon which several organic or inorganic layers are superimposed. It is the purpose of this paper to discuss an electroluminescent lamp which is sharply distinguished from former lamps by its flexibility (¾-inch minimum bend radius), its thinness (less than ½-inch thickness), its extreme light weight (3 ounces per square foot), its preponderance of organic materials, and finally, the ease with which it can be fabricated.

The major problem inherent in the development of such a plastic electroluminescent lamp is the detrimental effect of humidity on lamp performance. The lamp under discussion embodies a thin,

Author: Lamp Division, General Electric Co., Nela Park, Cleveland, Ohio.

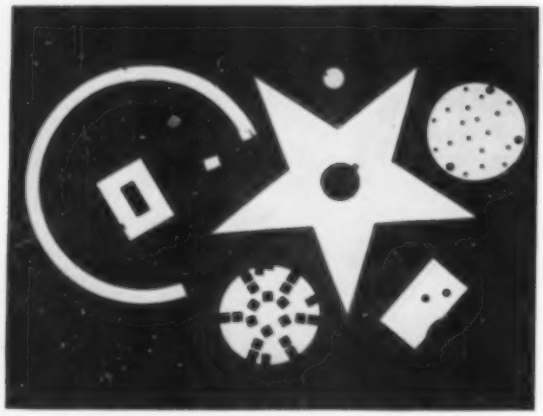


Figure 1. Various shapes of plastic electroluminescent lamps.

transparent, organic vapor barrier which will permit operation under extraordinary humidity conditions (75°F, 85 per cent relative humidity) free of the effects of humidity for a period of one year. Under more normal conditions, this period can be expected to reach two to three years.

Temperatures as high as 300°F have little or no effect upon the lamp structure. Although lamp brightness and maintenance are functions of temperature, long-term operation is dependent upon the average temperatures encountered, rather than any seasonal highs or lows.

In general, lamp brightness can be increased only at a sacrifice of life. A fortunate exception to this is found in the different response of green and blue lamps to applied voltage. By doubling the applied voltage we obtain a two-fold increase in brightness at no sacrifice in life.

It is likely that the most widespread and successful use of electroluminescent lighting will not be as a substitute for more conventional light sources but in areas which today are not even recognized as potential applications.

(Abstract of IES Conference Paper No. 2)

19 Thermionic Emission of Fluorescent Lamp Cathodes

J. F. Waymouth

C. L. Toomey

One of the most important aspects of a fluorescent lamp is the ability of its oxide-coated cathode to supply electrons to the discharge. This paper describes a method for measuring the Maximum Zero Field Thermionic Emission of a fluorescent lamp cathode with ease and precision and illustrates some of its applications.

The Maximum Zero Field Thermionic Emission technique utilizes the radio-frequency noise generated in the potential minimum adjacent to the cathode as a means of measuring the thermionic emission. This method is based on the disappearance of the potential minimum in front of the cathode when the discharge current ceases to be space-charge limited, as is illustrated in Fig. 1. In this drawing, the potential is plotted as a function of distance in front of the cathode for three different conditions of operation. Curve A is a condition where the discharge current is greater than the thermionic emission and an accelerating field exists at the cathode to increase the electron emission. Curve B is where the discharge current just equals the thermionic emission and no accelerating field exists at the cathode. Curve C is where discharge current is less than the thermionic emission and there exists a potential minimum in front of the cathode. Under condition C, mercury ions become trapped in the potential minimum and oscillate at a frequency of approximately 100 kilocycles. These oscillations may be detected in an external circuit and used to indicate the magnitude of the thermionic emission, since the oscillations cease (no potential minimum exists) when the discharge current equals the thermionic emission.

This new technique is a valuable tool with which to explore new areas of cathode behavior with complete confidence in results. For example, it has been applied to determining the effect of fill gas pressure as well as fill gas composition upon the

Authors: Sylvania Lighting Products Inc., Danvers, Mass.

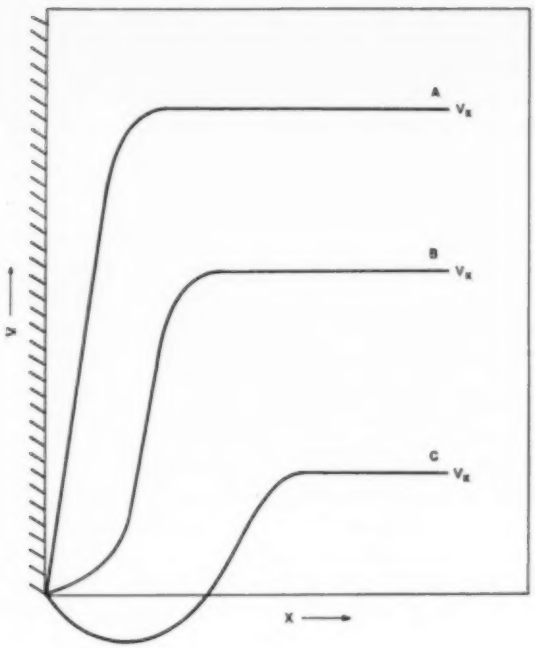


Figure 1. Potential in discharge *vs.* discharge in front of cathode for three different conditions of operation. A is discharge current greater than thermionic emission. B is discharge current equal to thermionic emission. C is discharge current less than thermionic emission.

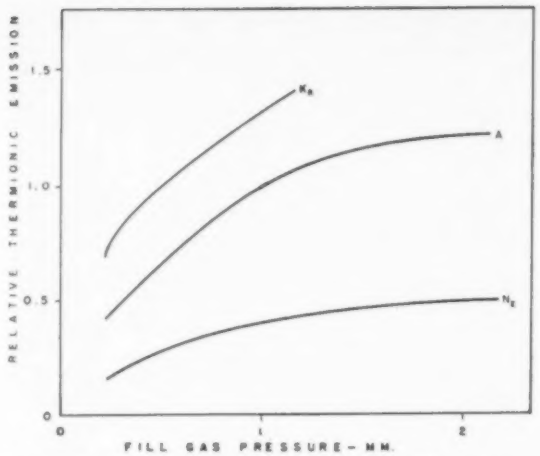


Figure 2. Relative thermionic emission *vs.* fill gas pressure for three different gases.

thermionic emission of fluorescent lamp cathodes. Fig. 2 illustrates the results.

The Maximum Zero Field Thermionic Emission technique is very rapid, produces accurate results, requires no special probes or internal lamp connections and can be applied to any fluorescent lamp. It is especially useful in the design of gas discharge devices employing thermionic cathodes.

(Abstract of IES Conference Paper No. 19)

16 New Compact Arc Lamps of High Power and High Brightness

Otto E. Lienhard

John A. McInally

THREE high-pressure, short-arc, d-c lamps have been developed: a pure xenon lamp, rated at 2.2 kw, and two xenon-mercury lamps rated at 2.5 and 5 kw, respectively. Combining a short arc length of 5 mm or less and a high operating pressure of 15 atmospheres or more results in more than double the brightness of earlier a-c lamps. The high brightness, stability and starting ease of these lamps, as compared with a-c lamps, makes them ideally suited for use in optical systems.

The lamps are constructed of pure fused quartz with anodes of pure tungsten and cathodes of thoriated tungsten in order to reduce the starting voltage (Fig. 1). A high current seal of four thin molybdenum foils sealed in parallel between concentric quartz tubes can carry 100 amperes continuously. Ignition is accomplished by imposing high-frequency, high-voltage pulses on the d-c line. A suitable resistance in series with the lamp limits the current to the required value. An electric motor-driven arc welder is a convenient and inexpensive power supply. With it ballast resistance is reduced to a minimum, keeping total power losses within 20 per cent of lamp power. This is comparable to a-c operated lamps.

Operating characteristics of all three lamps are shown in Table I. A typical brightness distribution, that of a 2.5-kw lamp, is shown in Fig. 2. Although the maximum brightness of the xenon

AUTHORS: Engelhard Hanovia, Inc., Hanovia Lamp Division, Newark, N. J.

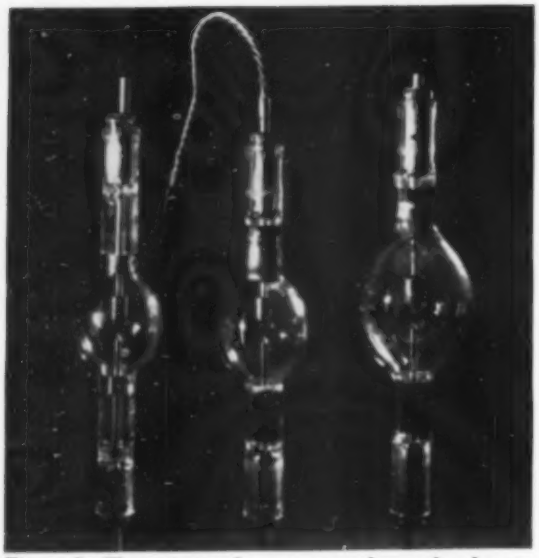


Figure 1. Three types of compact arc lamps for d-c operation. Left to right: 2200-watt xenon, 2500-watt mercury xenon, 5000-watt mercury xenon.

lamp is considerably greater than that of the 2.5-kw mercury, average brightness over the arc is less. This is due to an average cathode to anode brightness gradient five times greater than that of the mercury lamp. While the average brightness of the 5-kw lamp is 780 c/mm², brightness averaged over an area of 2 by 2 mm, including the cathode spot, is 1140 c/mm².

Because approximately seven times more energy is dissipated at the anode than at the cathode, the anode is necessarily a much larger electrode. An unsymmetrical polar light distribution results, because of the anode's shadow. The 2.5-kw lamp is therefore made in two types—with the anode as either the upper or lower electrode. In each case the arc is located one-quarter inch below the centerline of the bulb, in order to obtain a more uniform temperature distribution over the bulb surface. The properties of the optical system will determine the type used.

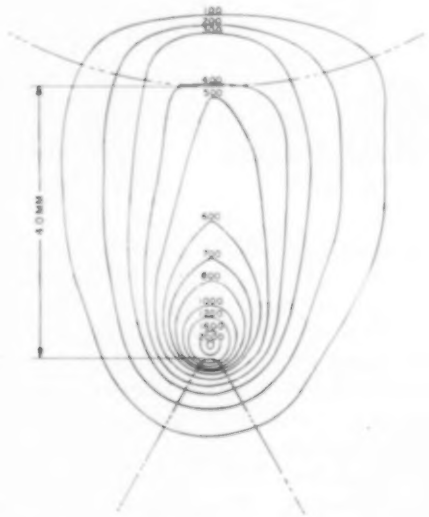


Figure 2. Brightness distribution, candles per square mm, of a 2500-watt mercury xenon lamp.

In xenon-mercury lamps the radiation is emitted in the mercury lines plus a continuum, with a few xenon lines in the infrared. With 2500 watts input, a total of 1980 watts are radiated; 1320 watts between 2000 and 14,000 angstroms. The xenon spectrum is a continuum with a few xenon lines, mostly in the infrared. Its visible light is closer to daylight than that of any artificial source. It has a very high intensity in the near infrared. While the ultraviolet radiation is not as strong as in the mercury discharge, it drops continuously to the absorption cutoff of quartz.

Tests of the xenon and 2.5-kw mercury lamp have shown useful lives (70 per cent of initial light output) of better than 1000 hours. No life data are available, as yet, on the 5-kw lamp. This lamp has been operated for several hours at 6 kw with an output of 280,000 lumens.

(Abstract of IES Conference Paper No. 16)

Table I—Characteristics of a Xenon and Two Mercury-Xenon Compact Arc Lamps for d-c Operation.

LAMP TYPE	491C	929B	932B
Gas Vapor	Xenon	Mercury-Xenon	Mercury-Xenon
Watts, Nominal	2200	2500	5000
Operating Voltage, Volts d-c	20 to 23	45 to 55	50 to 60
Current—Amperes d-c, Nominal			
Starting	100	100 max.	130 max.
Operating	100	50	100
Warm-up Time for Full Output, Minutes	—	8	8
Operating Vapor Pressure (Approximate Atmospheres)	16	18	15
Arc Length, mm, Operating	4.0	4.0	5.0
Brightness, c/sq. mm—Max.	3300	2050	2250
Average Brightness, c/sq. mm	440	540	780
For Arc Area: width × height, mm	2.5 × 4	2.5 × 4	3 × 5
Initial Lumens	75,000	120,000	230,000
Maximum over-all length, inches	12½	12½	13½
Bulb Diameter, mm	57	64	86
Bulb Length, mm	61	68	96
Bulb Wall Thickness, mm	3.5	3.5	4.5
Rated Average Life, Hours, at 12 hours per start	1000	1000	Experimental

1 Design and Application of Panel Type Fluorescent Lamps

C. M. Cutler

W. C. Martyny

ALTHOUGH tremendous strides in the development of the fluorescent lamps and the design of fluorescent equipments have been made over the past 20 years, luminaire designers, architects and lighting engineers have long wished for still newer forms of light sources from which to develop fresh-looking luminaires and lighting systems. Particularly strong feelings existed regarding the necessity of a smaller source which would provide as much (or more) light as the conventional fluorescent lamp.

This paper describes just such a new fluorescent lamp. It is a fluorescent panel lamp, one foot square and only one and one-half inches deep, which has the same high efficiency (60 lumens per watt) and long life (7500 hours at three hours-per-start) as characterize conventional tubular fluorescent lamps. The lamp is shown in Fig. 1.

It is felt that a compact square fluorescent lamp will extend the range of possible refinements that may be made in the design of luminaires and lighting systems. One of these refinements is the simplicity of corner designs that continue the architectural objectives of other parts of the lighting pattern. The style of ceiling luminaires or systems may be preserved; and by using lamps of different distributions, the designer may provide more light over specific areas. Opportunities are expected to be increased for the introduction of accents in patterns that are otherwise uniform. Light emission from two surfaces of the square creates further design flexibility. For example, color may be easily introduced into a unit whose source otherwise provides essentially white light. The waffle-pattern form of the face of the panel lamp lends itself to efficient designs of louvers for brightness control in a luminaire designed to use this lamp.

The luminaire mock-ups shown in Fig. 2 suggest some of the designs possible with the new compact panel fluorescent lamp.

(Abstract of IES Conference Paper No. 1)

AUTHORS: Lamp Division, General Electric Co., Nela Park, Cleveland, Ohio.

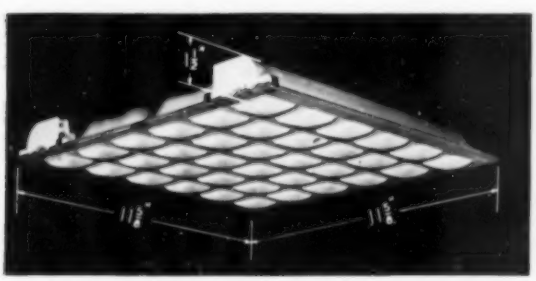


Figure 1. Panel fluorescent lamp. A connector has been designed which will fit between the two recessed bipin bases shown.

Figure 2. Four demonstration luminaires suggesting some design and application possibilities.

3 Fluorescent Lamps of Helicoidal Configuration

Joel Shurgan

Luke Thorington

BECAUSE of the relatively high proportion of power that is expended at the electrodes in fluorescent lamps (about 20 per cent in a 40-watt, T-12) it is expedient, for the sake of lamp efficacy and relative ballast losses, to develop as high a ratio of positive column power (at constant efficacy) to total lamp power as possible. Aside from the technique of changing lamp length to achieve this, there are two approaches which have found their way into commercial practice. One utilizes the substitution of neon for argon in various proportions and is used in lamps of both normal[1, 2] and above normal[3, 4] loadings. The other[5, 6] (for highly-loaded lamps only) makes use of a reduction in the cross sectional area of the bulb without substantially changing its perimeter. The latter is the approach which is of interest in the present paper. It is applied to lamp varieties having both normal and above-normal loadings in what is believed to be a novel manner.

All other factors remaining constant, it is well known that the voltage gradient in the positive column of a discharge lamp increases markedly with decreasing bulb radius because of the increased rate of loss of ions and electrons to the wall of the bulb. By analogy with the vibrations of a plane membrane held fixed at its perimeter, Spenke and Steenbeck[7] were able to extend the Schottky column theory to include other than round column cross sections. They worked out the relation showing the equivalency of the non-circular cross section with a circular cross section of radius R in terms of the lifetime, t, of ions and electrons in the column and, hence, of positive column gradient. Table I shows the equivalent radii, as determined from Spenke and Steenbeck, for various non-circular cross sections. By reference to the paper by van Boort and Kolkman,[8] it is possible to determine actual positive column gradients correspond-

AUTHORS: Duro-Test Corp., North Bergen, N. J.

Table I—Non-Circular Cross Sections in Terms of Equivalent Circular Cross Sections and Corresponding Lamp Voltages.

CROSS SECTION	DIMENSIONS	DIAMETER (MM) OF EQUIVALENT CYLINDRICAL BULB	LAMP VOLTAGE* EXPERIMENTAL	LAMP VOLTAGE* VAN BOORT *ET AL.* SPENKE *ET AL.*
Rectangular	26 x 48 mm	35.0	71***	67
Triangular (Equilateral)	a = 55 mm	36.4	69***	66
Semicircular } Annulus ("U")	r_i = 12.7 mm; r_o = 25.4 mm	19.1	....	76
Rectangular**	19 x 63.5 mm	27.9	....	71
Rectangular (a + b = 180 mm)	a/b = 1	43.3	....	62
Rectangular (a + b = 180 mm)	2	36.6	....	66
Rectangular (a + b = 180 mm)	4	23.8	....	73
Rectangular (a + b = 180 mm)	6	17.3	....	76
Rectangular (a + b = 180 mm)	8	13.5	....	79
Rectangular (a + b = 180 mm)	10	11.2	....	80

*Lamp held at 40°C; V_a = 17 v.; positive column length = 101 cm.
**"Q" = 28; cf. reference 5, page 580.
***1.5 amperes.

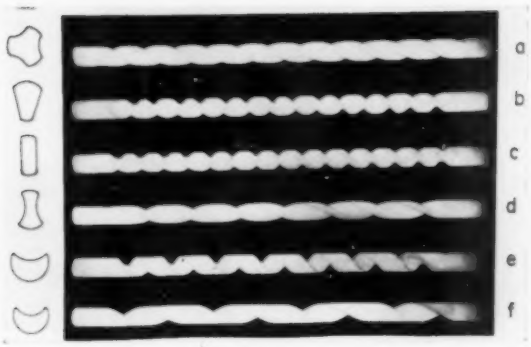


Figure 1. Four-foot T-17 1.5-ampere helicoidal lamps burning:

(a) ten-inch pitch triangular cross section;

(b) five-inch pitch eccentric wedge cross section;

(c) five-inch pitch rectangular cross section;

(d) ten-inch pitch near-rectangular (hour glass) cross section;

(e) five-inch pitch approximately semicircular cross section;

(f) ten-inch pitch "U" cross section.

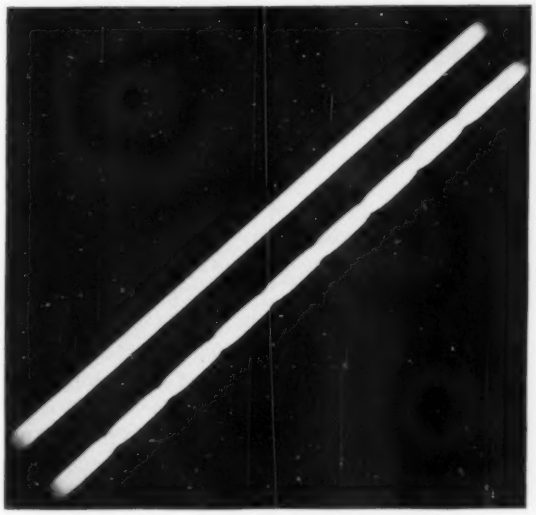


Figure 2. Standard 40-watt T-12 and T-12 helicoidal lamp having a near-rectangular cross section and a ten-inch pitch.

ing to columns having these radii and hence actual lamp volts.

Since Spenke and Steenbeck have demonstrated that the non-circular cross section can be expected to result in increased positive column gradients with the attendant advantages, it remains only to determine the best practical application. One such application has already been mentioned,[5, 6] and it is the purpose of this paper to describe others.

If a given non-circular cross section is rotated as it is made to advance along an axis in space, a geometrical form known as a helicoid or screw is formed. When this is done with a thin-walled, hollow, non-circular section, one obtains a tube having, at any point, the same cross section normal to its axis and yet possessing the over-all characteristics of a cylinder with respect to rolling, flexing, etc. It will be realized that when this is done with an asymmetric cross section there results an increase in total path length which a discharge will follow down such a helicoidal tube compared with the straight line axial distance.

As an example of the versatility inherent in the helicoidal or spiral geometry there is shown in Fig. 1 a photograph of six 4-foot, 1.5-ampere helicoidal lamps of different cross sections and pitches taken in their own light. Fig. 2 shows the principle applied to the 40-watt T-12 lamp. These lamps show entirely satisfactory mechanical strength and resistance to implosion for nominal wall thicknesses as might be expected from the basic geometry and mechanics involved. It might be added that the helicoidal bulbs fit admirably into a routine production operation designed for cylindrical bulbs; they bundle, roll, and coat as cylinders and, in general, have all the desirable characteristics of cylinders, while retaining the non-circular cross section.

The new design has been used to advantage in the 40-watt T-12 lamp in both preheat and rapid-start types, where an approximately 10 per cent increase in light output is realized, and in the highly loaded 1.5-ampere T-17 lamp, where brightness uniformity, high efficiency, high loading capability and orientation insensitivity (horizontal burning) are outstanding advantages.

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(Abstract of IES Conference Paper No. 3)

14 Characteristics of Ribbon Filament Lamps

Leroy G. Leighton

THE INCREASED use of tungsten ribbon filament lamps during the past few years has brought forth many questions concerning their characteristics. The available information has been collected in an attempt to supply the answers to some of these questions.

Ribbon filament lamps are made with ribbon widths from 0.7 mm to 4 mm, and in lengths up to 50 mm. In general, 9-ampere lamps use 1-mm ribbons, 18-ampere lamps use 2-mm ribbons, and 20- and 30-ampere lamps use 3- or 4-mm ribbons. The volt-ampere rating applied to many of these lamps is a nominal rating, usually applied for identification purposes. They are not designed for a given life at a certain voltage or current. In many cases the lamps are calibrated for temperature and current over the range of temperature which is of interest to the user. An example of this type of service might be a lamp used for maintaining a temperature scale, or for pyrometer calibration.

AUTHOR: General Electric Co., Nela Park, Cleveland, Ohio.

Typical Ribbon Filament Lamps

Some of the more popular ribbon filament lamps are shown in Fig. 1. At (a) are two 6-volt, 9-ampere, T8½ lamps, an SR8 filament on the left and an SR6 filament on the right. At (b) are two 6-volt, 18-ampere, T10 bulb lamps, an SR8 on the left and an SR6A on the right. At (c) is the 6-volt, 30-ampere, SR8, T24 bulb Pyrometer lamp, and at (d) is the 6-volt, 30-ampere, SR8, T24 Spectrographic lamp with a quartz window.

Characteristics

The characteristic curves for ribbon filament lamps, relating volts, amperes, lumens, efficiency, color temperature, and life, are of the same expo-

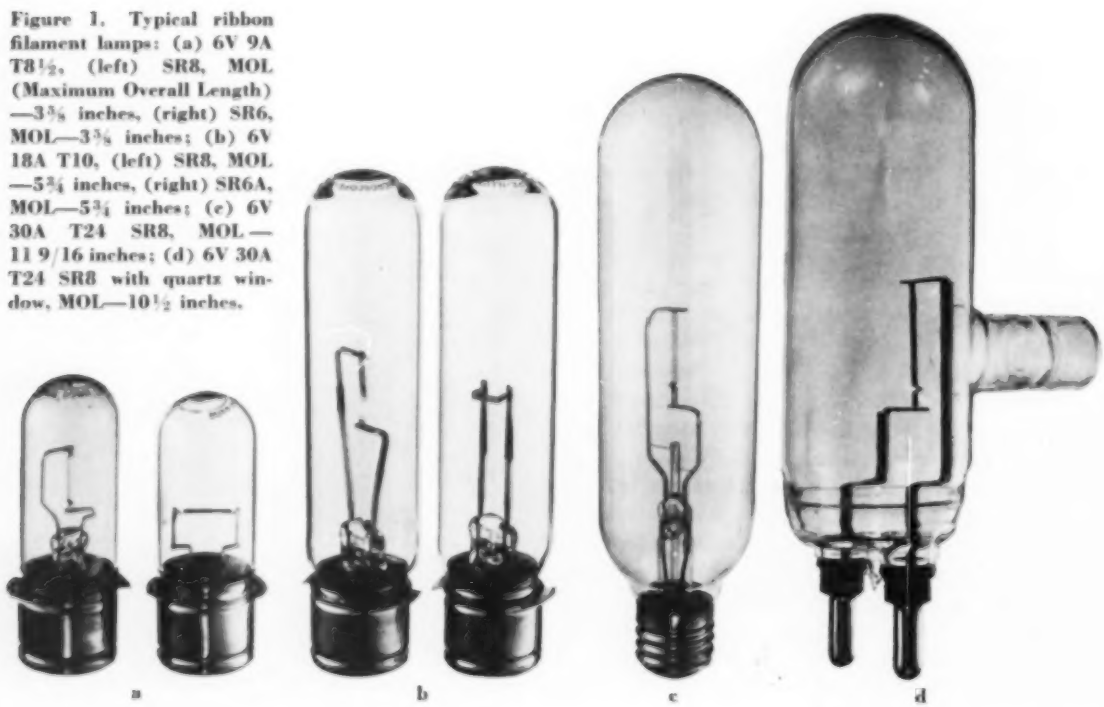

Figure 1. Typical ribbon filament lamps: (a) 6V 9A T8½, (left) SR8, MOL (Maximum Overall Length) —3⅜ inches, (right) SR6, MOL—3⅜ inches; (b) 6V 18A T10, (left) SR8, MOL —5¾ inches, (right) SR6A, MOL—5¾ inches; (c) 6V 30A T24 SR8, MOL — 11 9/16 inches; (d) 6V 30A T24 SR8 with quartz window, MOL—10½ inches.

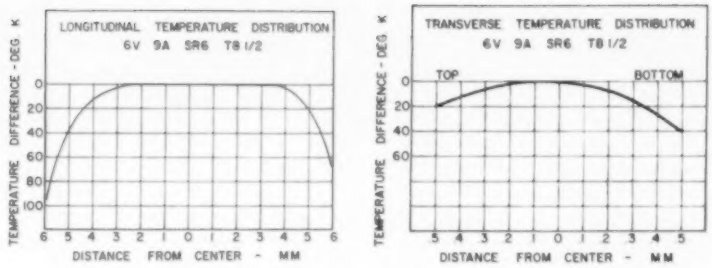

Figure 2. Ribbon filament temperature distribution, (a) 6V 9A SR6 longitudinal, (b) 6V 9A SR6 transverse.

Table I — Ribbon Filament Characteristic Exponents

LAMP TYPE	f	y	j	c	k	g	m
6V 9A	0.502	7.63	4.64	0.762	3.83	2.33	0.383
6V 18A	0.533	7.07	4.19	0.727	3.77	2.23	0.387
6V 30A	0.579	6.40	3.70	0.673	3.71	2.14	0.390

nential form as the equations used for standard incandescent lamps.

The characteristic relationships which are usually of interest are as follows:

$$\left(\frac{\text{volts}}{\text{VOLTS}}\right)^{f}=\left(\frac{\text{amperes}}{\text{AMPERES}}\right)$$

$$\left(\frac{\text{amperes}}{\text{AMPERES}}\right)^{y}=\left(\frac{\text{lumens}}{\text{LUMENS}}\right)=\left(\frac{\text{volts}}{\text{VOLTS}}\right)^{k}$$

$$\left(\frac{\text{amperes}}{\text{AMPERES}}\right)^{j}=\left(\frac{\text{lumens per watt}}{\text{LUMENS PER WATT}}\right)=\left(\frac{\text{volts}}{\text{VOLTS}}\right)^{g}$$

$$\left(\frac{\text{amperes}}{\text{AMPERES}}\right)^{c}=\left(\frac{\text{color temperature}}{\text{COLOR TEMPERATURE}}\right)=\left(\frac{\text{volts}}{\text{VOLTS}}\right)^{m}$$

Table I lists the values for these seven exponents for several of the most widely used ribbon filament lamps. These exponents will hold closely for values of current and voltage normally used, *i.e.*, for color temperatures in the range of 2300°K to 3200°K.

Temperature Distribution

The temperature distribution along the length of a ribbon filament is not absolutely uniform, due mainly to the end losses to the heavy leads. A typical temperature distribution curve is shown in Fig. 2a for the 6-volt, 9-ampere, T8½ lamp, which shows a drop of approximately 100 degrees at the lead. The temperature across the width of a ribbon likewise will vary, due to gas losses. Fig. 2b shows the transverse temperature distribution for this same 9-ampere lamp.

(Abstract of IES Conference Paper No. 14)

12 Modified Current Wave Shapes and Starting Voltage Limits for Mercury Lamps

AN EARLIER paper by Martt and Smith[1] outlined the effects of high lamp-current crest factor on the lumen maintenance of general lighting mercury lamps. This paper extended the data to include the improved oxide-electrode type lamp which is rapidly gaining wide acceptance in the industry. With this lamp, higher current crest factors show only slightly lower lumen maintenance.

Data are included for horizontal and vertical operation at five and ten hours per start on six different ballasts. These include one lag ballast and

R. J. Smith

W. C. Matz

AUTHORS: General Electric Co., Nela Park, Cleveland, Ohio.

five stabilized ballasts of commercial design, covering a crest factor range from about 1.4 to 2.0. Lumen maintenance was evaluated through 4000 hours of burning. Data show that in the commercial type of ballast tested, a lamp-current crest factor as high as 2.0 should give a reasonable level of lamp performance for the oxide-electrode lamp.

In the second part of the paper it is shown that the starting voltage of the thorium-tungsten and oxide-electrode quartz mercury lamps is dependent on both peak and rms voltage. Lamps were started at −20°F on lag ballasts and on special circuits designed to permit variation of open-circuit voltage crest factor. It was found that if the rms is decreased, the peak voltage must be increased somewhat to maintain starting reliability. For example, a ten per cent reduction in the near sine wave value as specified by the American Standards Association requires a five per cent increase in peak voltage. This relationship enables ballast manufacturers to take advantage of nonsinusoidal wave shapes that exist in some types of ballasts.

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(Abstract of IES Conference Paper No. 12)

15 Xenon High-Pressure Lamps— New Designs Demonstrate Their Versatility

Wolfgang E. Thouret

Herbert S. Strauss

XENON high-pressure lamps find increasing interest as concentrated and powerful light sources. They can combine the high brightness of carbon arcs with the maintenance-free and clean operation of regular discharge or incandescent lamps. At a usefully high efficacy, they have an energy distribution virtually identical with that of sunlight.[1] The versatility of the xenon arc as a high brightness source is demonstrated by three new short-arc lamp groups with extreme characteristics: Small wattage point source types in the 50- to 100-watt category; a triple-arc 2000-watt lamp with horizontally elongated source for low-voltage d-c operation; and a single-arc 10-kw lamp far surpassing all earlier designs in wattage and lumen output.

Small Wattage Short-Arc Lamps in 50- to 100-Watt Power Category

In optical apparatus requiring a light source of low wattage, high brightness, and small dimensions, special incandescent lamps are usually used. However, their brightness is limited to a maximum of 30 cd/mm² at a very short life. Carbon arcs, which would supply up to 30 times the brightness of incandescent lamps, are only available in rather large wattages, and often impractical because of their volume, weight, and maintenance requirements. Consequently, there is a definite need for small wattage lamps with high brightness in the carbon arc range.

This need can be filled with a group of short-arc xenon lamps in the 50- to 100-watt power category which was developed recently. Table I gives their main data. Main construction features and most dimensions of the lamps are the same. However, they differ in one important design characteristic—length of the arc or electrode spacing. One type has an extremely short arc of only 0.16 mm length in operation, while the electrode tips of the other type are spaced at 2 mm. This marked difference in arc length leads to radically different brightness and efficacy values as can be read from Table I.

The decisive influence of the arc length on the optical lamp characteristics is a consequence of basic properties of the short arc high pressure discharge. The brightness and luminous efficacy of

AUTHORS: Duro-Test Corp., North Bergen, N. J.

Table I—Approximate Data of New Xenon Short Arc Lamps for D-C Operation.

LAMP WATTS	ARC VOLTS IN OPERATION	OPERATING CURRENT AMPERES	AVERAGE BRIGHTNESS IN ARC CENTERLINE CANDLES/MM²	PEAK BRIGHTNESS (IN CATHODE SPOT) CANDLES/MM²	ARC LENGTH IN OPERATION MM	INITIAL LUMENS	INITIAL LUMENS/WATT	INTERNAL OPERATING PRESSURE ATM.	MAXIMUM BULB OUTER DIAMETER (INCHES)	MAXIMUM OVER-ALL LENGTH (INCHES)
50	13.0	3.8	800	1800	0.16	200	4.0	30	7/16	4¼
50	22.0	2.3	70	560	2.0	500	10.0	30	7/16	4¼
75	13.3	5.6	1250	3200	0.16	450	6.0	30	7/16	4¼
75	23.0	3.3	130	1300	2.0	940	12.5	30	7/16	4¼
100	13.5	7.4	1700	4000	0.16	750	7.5	30	7/16	4¼
100	24.0	4.2	170	2000	2.0	1500	15.0	30	7/16	4¼
3 x 660	20.0*	33*	300*	1200*	3.0*	56,000	28	20	2⅛	14
1 x 2000	22.0	91	700	3000	3.0	64,000	32			
10000	40.0	250	1450	7600	8.3	410,000	41	6	4	28
8000	37.5	213	1250	6800	8.3	320,000	40	6	4	28
5000	32.5	154	850	5300	8.3	185,000	37	6	4	28
5000	25.0	200	2100	6500	2.0	140,000	28	6	2½	28

*The three arcs have approximately the same data.

Required supply voltage: 28 to 80 volts d-c. A high voltage pulse circuit is required for starting. No forced air or liquid cooling is required. Lamp enclosures must be sufficiently large or ventilated in order to prevent overheating.

Standard burning position for all lamp types is "vertical ±15 degrees" with the anode up. Larger deviation from the vertical position may reduce life and lumen maintenance.

Because of their high internal pressure the lamps must be operated at all times in solid housings in order to exclude any safety hazard to persons. In addition, safe protection from the intensive UV-radiation has to be provided. The lamps are supplied within protective cases that are to be removed only after installation in the operating enclosure.

xenon short arc lamps have been measured as a function of electrode spacing at constant pressure and wattage for 50, 75, and 100 watts. With decreasing arc length the brightness values increase at first slowly but in the range of small electrode spacings very rapidly, almost like an exponential function.

Triple-Arc 2000-Watt Lamp with Horizontally Elongated Source for Low-Voltage d-c Operation

The usefulness of special military searchlights equipped with xenon short-arc lamps could be improved through a type with horizontally elongated source shape.[2] Desirable source data are, *e.g.*, 3.0-mm height, 20- to 25-mm width, 2000-watt power consumption. Such dimensions can be achieved with a horizontally burning magnetically stabilized arc.[3] However, for the contemplated application, the available maximum supply voltage is 28 volts d-c, and xenon high pressure arcs of 20- to 25-mm lengths require a much higher voltage power supply. Under these conditions, the desired source dimensions can only be obtained with several short arcs of 3-mm length burning vertically in the same envelope. The arcs have to be operated in parallel circuits with separate ballast resistors between electrically separated electrode pairs.

For the reasons outlined, the behavior of multiple xenon high-pressure arcs was studied and, as a result, a 2000-watt triple-arc lamp was developed. It provides a horizontally elongated source by means of three arcs of 660 watts each, burning vertically in separately ballasted parallel circuits from a 28-volt d-c supply. An additional feature is that, through suitable dimensioning of the center electrode pair, the center arc can be operated either with 660 watts or with the full lamp wattage of 2000 watts. Thus, the lamp can be operated either with horizontally elongated or concentrated point source by switching the two 660-watt side arcs on or off and simultaneously adjusting the center arc load to either 660 or 2000 watts, by means of a ballast resistor change.

10-kw Short-Arc Lamp

The largest wattage xenon short-arc lamp types developed so far and made available for practical use in Europe and in this country are in the 1600- to 2500-watt category.[4-6] A 3000-watt lamp and a 4000-watt type with forced air cooling have been developed in Japan.[7] For many important applications, *e.g.*, military searchlights, motion picture theater projectors and space simulator installations, units of much larger wattage are required. In order to meet this demand, development work was started with the objective of creating reliably op-

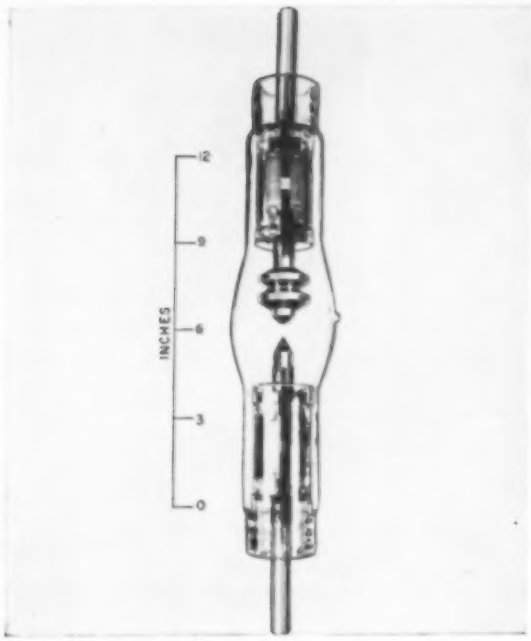

Figure 1. Ten-kw xenon short arc lamp (operating data: 40 volts, 250 amperes, d-c; electrode spacing in operation: 8 mm).

erating lamp designs in the 5-, 10-, and 20-kw category, suitable for replacing the presently used carbon arc lamps of corresponding wattage.

A first result of this program is a 10-kw lamp with an approximate arc length of 8 mm and an average brightness in the arc centerline of 1450 cd/mm^2. Fig. 1 shows its design and outward appearance. Table I gives the electrical and optical characteristics of the lamp when it is operated at full wattage and in underloaded condition at 8 and 5 kw. These values indicate the variations in data obtainable through variation of wattage.

Fig. 2 presents information on the brightness distributions obtained. As expected, the curves of equal brightness delineate a brightnesss pattern and a source shape similar to those of lower wattage d-c lamps. The arc is highly concentrated directly at the cathode tip and there produces peak brightness values up to 7600 cd/mm^2. Towards the anode the arc widens and its brightness decreases. However, due to the relatively small spacing between the electrode tips, the cathodic arc constriction prevails through a major portion of the entire arc. Thus, the very high average brightness figures listed in Table I are achieved. They compare favorably with the highest published brightness data of similar wattage high intensity carbon arcs: 950 cd/mm^2 for a 13.3-kw (180 amperes, 74 volts) arc with 13.6-mm positive carbon diameter[8] and 1300 cd/mm^2 for a 12.7-kw (190 amperes, 67 volts) arc with 11-mm positive carbon diameter.[9] Also, the luminous efficacy values of the high powered xenon short-arc lamps, as listed in Table I, are remarkable when compared with the efficacy of high intensity carbon arcs of similar wattage. This ranges between 28 and 33 lumens per watt.[8]

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(Abstract of IES Conference Paper No. 15)

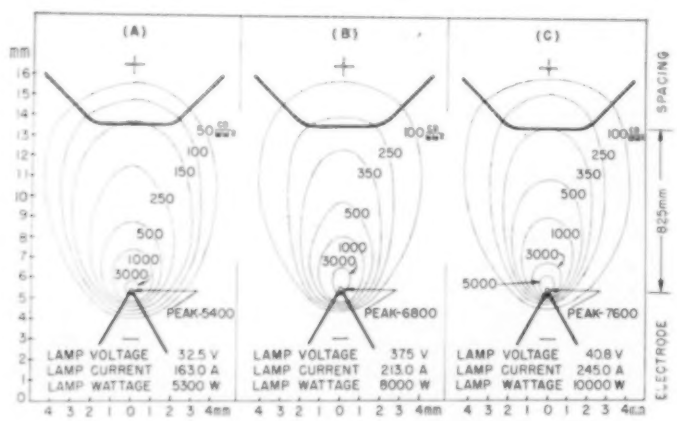


Figure 2. Brightness distribution of ten-kw xenon short arc lamp operating at 5, 8, and 10 kw.

IV. PHOTOMETRY

31 Matched Filament and Reflector Contours

Domina Eberle Spencer

THE PURPOSE OF this paper is to study how a given beam pattern can be produced most effectively. Incandescent filaments and specular reflectors will be assumed. The problem is to match the filament and reflector contours in such a way that both are utilized as effectively as possible. All the light radiated from the filament should be directed into the desired beam pattern. For a given filament, the smallest possible reflector that will control the light should be employed. For a given reflector, the minimum filament contour that will produce the desired beam pattern should be used.

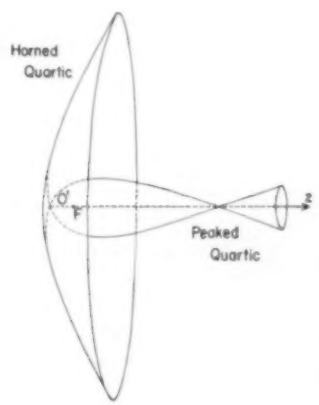


Figure 1.

The paper suggests the study of a family of fourth-degree surfaces called *peaked and horned quartics* (Fig. 1) as reflector contours. Both peaked and horned quarties tend to produce a minimum of reflected light on the axis surrounded by a bright annular ring. This can be balanced against the direct light from the filament which has a maximum on the axis. In this fashion, large areas may be uniformly illuminated with surprisingly compact filament-reflector combinations.

The technique of matching filament and reflector contours depends upon the development of a new set of curves (Fig. 2). These curves are a family

AUTHOR: University of Connecticut, Storrs, Conn.

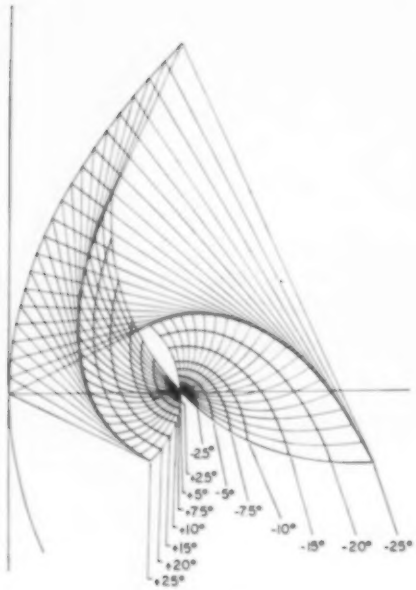


Figure 2.

of cubics which define the region which must be filled by the filament if a given portion of the reflector is to be filled with light when viewed at a given angle.

Extensive use has been made of these filament contour curves over the past two years. An example of a practical reflector employing a peaked quartic and designed by these new techniques is shown in Fig. 3.

Figure 3.

The paper also establishes the principle of employing modulated reflectors to eliminate filament images with minimum distortion of the desired beam pattern. The reflector shown in Fig. 3 was modulated in the vertical direction to eliminate filament images which (for the unmodulated reflector) appeared as nearly vertical stripes.

(Abstract of IES Conference Paper No. 31)

9 Zero-Length Searchlight Photometry System

John Johnson

THE PHOTOMETRY OF large aperture radiation projectors such as searchlights involves a number of experimental difficulties. In particular, measurements of angular candlepower distributions require "test throws" between searchlight and measuring light cell of up to 1000 feet for large-aperture searchlights. The disadvantages of an outdoor 500- to 1000-foot photometry test range are obvious.

A new general experimental procedure for the measurement of candlepower distributions of large searchlights in the laboratory at very short test distances has been developed. This method is based on the principle of inverse beam collimation. The projected beam from the test searchlight is accepted and focused by a large lens or mirror into a focal plane image. It can be shown that such a focal plane image bears a one-to-one angular correspondence to the searchlight beam formed at infinity. A relationship is derived between the illumination in the focal plane image and the projected candlepower of the searchlight, in a particular spatial direction. The facility is shown in Figs. 1 and 2. Basically, this facility consists of a goniom-

AUTHOR: Chief, Research Section, Warfare Vision Branch, U. S. Army Engineer Research and Development Laboratories, Ft. Belvoir, Va.

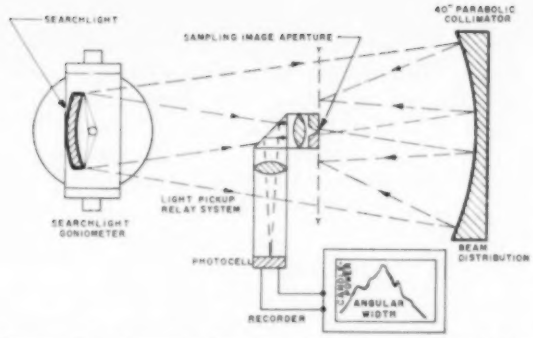


Figure 1. Schematic diagram of zero-length searchlight photometry system.

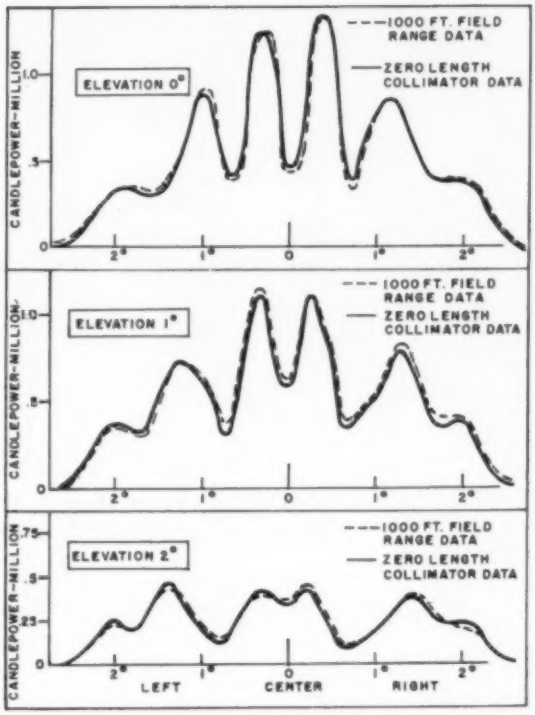


Figure 3. Comparison of searchlight intensity distributions as measured on the zero-length laboratory facility and on a 1000-foot long field range.

eter to position and rotate the test searchlight and an $f/4$, 40-inch diameter parabolic collimator mirror to accept and focus the searchlight beam onto an illumination measuring aperture (1 mm) located at the focal point of the parabolic mirror. The goniometer is electrically programed to follow automatic raster-type angular movements in the horizontal and vertical planes. It is important to note that illumination measurements on the zero-length test facility are made only at the focal point of the collimator mirror. This insures a constant high optical performance on the part of the measurement system independent of the beam width of the test searchlight.

Fig. 3 presents some of the horizontal beam distribution of a tungsten searchlight as measured on the laboratory facility and on a 1000-foot field range. The average comparison error was about three per cent and was most likely due to focus adjustment and mismatch in elevation angles of the compared distributions. Image analysis by the point-response method indicates that if the angular optical quality of the collimator exceeds the angular optical quality of the searchlight reflector by a factor of ten, the maximum error in the off-axis beam position will be on the order of one per cent.

(Abstract of IES Conference Paper No. 9)

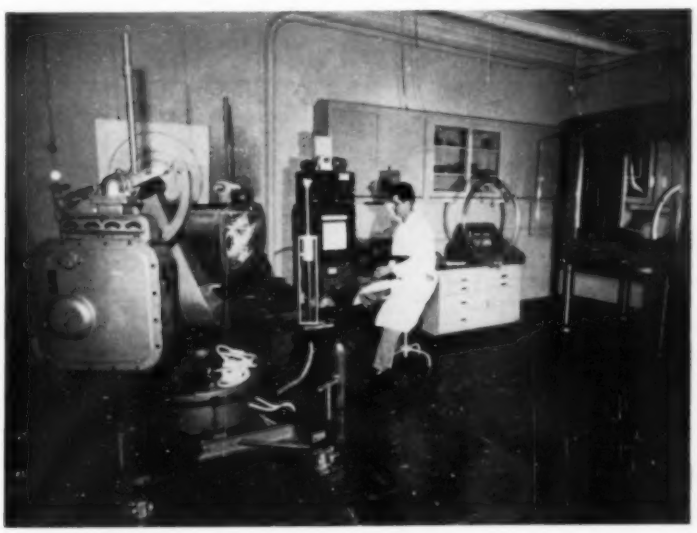


Figure 2. Photograph of actual zero-length searchlight photometry system.

Stanley M. Segal

Steve B. Gibson

11 Searchlight Beam Spreads from Horizontally Elongated Sources

IN PARABOLIC projection systems utilizing sources of small diameter, bean spread is accomplished with Fresnel lenses or by defocusing the source. These two methods substantially decrease the peak beam candlepower of the system. Since beam divergence is dependent upon the radius of the light source and the focal length of the reflector, a spread beam can be realized by using a horizontally elongated source. Three such experimental sources were examined for this application: a four-electrode a-c carbon arc; a three-cathode d-c xenon arc; and a horizontally elongated d-c carbon arc source. The first two were evaluated in standard searchlight housings using 18-inch reflectors. The d-c carbon arc lamp was examined in a standard 60-inch searchlight housing utilizing 60-inch and 35-inch reflectors. The beam candlepower and beam spread characteristics of each of these systems were measured on a searchlight range facility. In addition, visual and photographic comparisons were made of target illumination effects.

It is noted that in the three-cathode xenon lamp the option exists of using it as a narrow beam source. When greater power is required in the center of the beam, at the sacrifice of beam spread, the entire 2000 watts, which are normally distributed over three arcs, may be switched to the central cathode.

The advantages and possible applications of wide-beam high-intensity searchlight beams are dramatized in Fig. 1. These photographs of a simulated situation compare (a) the narrow beam of the regular 60-inch searchlight with (b) the wide beam of the horizontally elongated d-c carbon arc source in a 60-inch searchlight. While both beams are focused in these photographs, the truck and tank on either side of the jeep are seen only with the wide-beam searchlight. Here the usefulness of wider beam spread, without central defocusing, is readily evident.

The rectangularly shaped sources and systems described are experimental and would require additional engineering to be perfected. The purpose of this paper is to describe the possibilities of shaped sources in obtaining wide-beam spreads in searchlights, without the very sharp decrease in peak beam candlepower attendant to the use of refractive dispersion or defocusing techniques.

(Abstract of IES Conference Paper No. 11)

AUTHORS: Light Source Unit, Warfare Vision Branch, Electrical Department, U. S. Army Engineer Research and Development Laboratories, Ft. Belvoir, Va.

(a)

(b)

Figure 1. Comparison of (a) the narrow beam of a standard 60-inch searchlight with (b) the wide beam of the elongated d-c carbon arc source in a 60-inch searchlight in a simulated application. Ranges, camera positions and camera settings were identical for both photographs. Power consumption in each case was similar.

10 Photometry of Fluorescent Luminaires —Rotating Photocell Method

Donald Dunlop

D. M. Finch

AN IMPROVED method of photometry is needed for highly-loaded fluorescent lamps and their associated luminaires. Also the increased use of integrated ceilings and luminaires makes it necessary to have a photometric technique that is suitable for use with large area sources. There are numerous problems in the photometric laboratory caused by the highly-loaded and/or large area sources. Among these are the ambient temperature effects, drafts, chimney effects, electrical stability, sag or distortion of the luminaire components, and the large physical size of many luminaires and sections of integrated ceiling lighting systems which make it difficult or impossible to use the conventional techniques for photometric testing.

A simplified method of photometry, which is called the "Rotating Photocell Method," has been developed and successfully used. The method gives identical efficiency and coefficients of utilization, within the limits of accuracy of the measuring instruments, when compared with the conventional methods of photometry. The *apparent* intensity (candlepower) distributions will differ slightly but not significantly from conventional 40-foot test distance measurements. For example, one typical comparison is shown in Table I. The rotating photocell method described in this paper solves or minimizes most of the problems of fluorescent luminaire photometry. With this method, the luminaire is mounted and maintained in its normal mounting position in a standardized ambient temperature. A photocell is rotated on a relatively short radius about the luminous centroid of the luminaire. Enough measurements are made to allow an accurate summation of flux, using the zonal integration method.

When the method was proposed several years ago, it was realized that test data would be required to show that this method is in agreement with the two methods of photometry for fluorescent luminaires that are now in common usage—*viz.*, a stationary photocell with the luminaire rotated about a horizontal axis, or rotated about a vertical axis. A series of comparison tests have been made and are reported herein. Various luminaires typical of the distributions and lamp outputs that are commonly encountered were selected for the tests. Each luminaire was tested by the three methods outlined above and then compared for efficiency, candlepower distribution and coefficients of utilization.

We propose that this method should be adopted by the IES as an alternate test procedure for fluorescent luminaire photometry.

(Abstract of IES Conference Paper No. 10)

AUTHORS: Research Engineer, Hexcel Products Inc., Berkeley, Calif., and Professor, Research Engineer, Institute of Transportation and Traffic Engineering, University of California, Berkeley, respectively.

TABLE I

LUMINAIRE NO. 2 DIRECT-INDIRECT TYPE		40-FOOT—VERTICAL ROTATION	40-FOOT—HORIZONTAL ROTATION	10-FOOT—ROTATING PHOTOCELL METHOD
Efficiency		85%	84%	85%
K_u (for F-room)	80% ceiling 50% wall 30% floor	0.53	0.53	0.54
Apparent Candlepower	I0°	811 cp	783 cp	805 cp
Apparent Candlepower	I45°	528 cp	512 cp	566 cp
Apparent Candlepower	I90°	22 cp	22 cp	17 cp

V. APPLICATIONS

6 Design of Large-Scale Electroluminescent Panel Lighting Systems

Joel E. Rubin

Philip F. Dietz

THE ULTIMATE possibilities of a thin, wide-area, variable-color, variable-brightness light source with wide flexible applications are virtually boundless. The field of lighting esthetics has, in general, agreed that the controllable properties of light are its brightness, color, form, and changes or movement in these. The electroluminescent panel source is amenable to exacting control over these properties. Furthermore, if it lacks the ability to be directed, associated in a conventional sense with the incandescent point source or with the fluorescent linear source, it offers a form of adaptability which is purely achitectonic in concept.

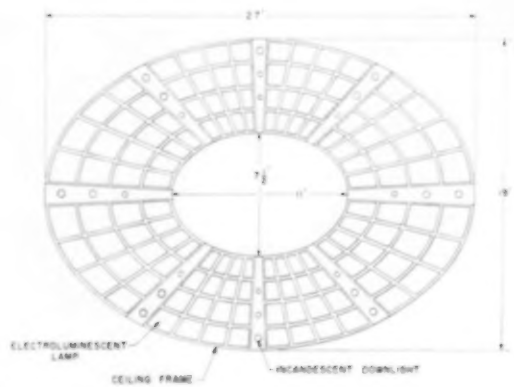


Figure 1. An outline drawing showing the completed installation.

The phenomenon of electroluminescence, as evidenced by the panel light sources, offers great possibilities for the complete integration of lighting in

AUTHORS: Kliegl Bros., New York, N. Y., and Westinghouse Lamp Division, Bloomfield, N. J., respectively.

architectural and interior designs. Electroluminescent panels are far from being a mere laboratory source. The chief deterrent to a major illuminating breakthrough for the panel source on the commercial market is its present low efficiency compared to more conventional sources. This point need not deter many architectural and design applications. In the major installation described in this paper the designer's aims were achieved through the use of the electroluminescent source. Drawing of completed installation is shown in Fig. 1. Fig. 2 is a photograph of a completed section of fixture with electroluminescent panels. It is problematical whether other sources would have resulted in as effective an installation.

(Abstract of IES Conference Paper No. 6)

Figure 2. Photograph of completed section of fixture with electroluminescent panels.

34 Ballast Thermal Protection

D. Lovinger

BALLAST FAILURE CAN sometimes be accompanied by conditions which may cause personal and property damage. Although the risk is quite small, it is one the fluorescent lighting industry must face.

The average class A insulated fluorescent lamp ballast will, in the normal course of its life, experience insulation degradation that eventually results in failure. A ballast can fail in several ways. First, and least likely to occur, is the occasional failure of ballasts that results in smoking and even luminaire eruption. Second, is the failure of a component or part of the ballast insulation that results in a more subtle form of visible evidence of ballast failure. Third, and most common, is the kind of failure which results in the inability of the ballast to start and operate lamps.

For better understanding of how to guard against the undesirable conditions that sometimes can result from ballast failures, it is necessary to know the external manifestations of the fault and how they can be detected. Ballast failures that can cause undesirable conditions fall roughly into three categories. First, those failures of insulation materials and components that result in excessive input curent and, in most cases, excessive heating; second, those ballast failures that result in excessive heating which can in turn result in leakage without a large increase in input current to the ballast; and third, the failure of the ballast insulation system or components that can result in leakage without either increases in line current or heating.

It is apparent that to protect the ultimate light user from the undesirable conditions that can occur as a result of ballast failure, more than one degree of protection must be employed. With today's ballasts, it would seem necessary that protection must take the form of: (1) excessive current sensitivity in the form of either branch circuit protectors or individual ballast fuses; (2) ballast thermal protectors to detect ballast core and coil overheating; and (3) temperature-sensitive devices in ballast capacitors to prevent the rupture of capacitor containers.

(Abstract of IES Conference Paper No. 34)

AUTHOR: General Electric Co., Ballast Department, Danville, Ill.

21 Combating Juvenile Delinquency with Light

Alexander Lurkis

In September 1959, headlines in the New York City press reported that two young hoodlums had stabbed to death a teenager who had been sitting on a bench in a playground. This playground had no lighting. At a special conference called by the mayor the following morning, it was agreed that unlit playgrounds were a haven for delinquents and that a program for lighting playgrounds should be developed.

A list of 392 playgrounds, arranged in order of priority of problem areas, was divided further into groups with similar lighting problems: (1) Playgrounds having no light and no trees could be illuminated from the exterior; (2) playgrounds having no light, but containing trees, could be lighted from the interior and exterior; and (3) playgrounds containing trees and some interior lighting to be lighted from the exterior with new interior lighting as well. Also, the following assumptions were made. All playgrounds are open at all times. These playgrounds must be kept lit during the entire lighting cycle by automatic control. Lighting was not to be application lighting for specific sports but security lighting.

Plans became a reality as exterior lighting was provided by floodlights placed on high (26-foot 8-inch) poles. For interior lighting, where trees blocked the height and poles could not be reached by trucks, low pole lighting was used. The light selected was a 400-watt coated mercury lamp, which has a 60-degree beam spread and a 40,000 maximum candlepower. With constant wattage ballasts located in the lamp post base, mercury street light-

Author: Bureau of Gas and Electricity, Department of Water Supply, Gas and Electricity, New York, N. Y.

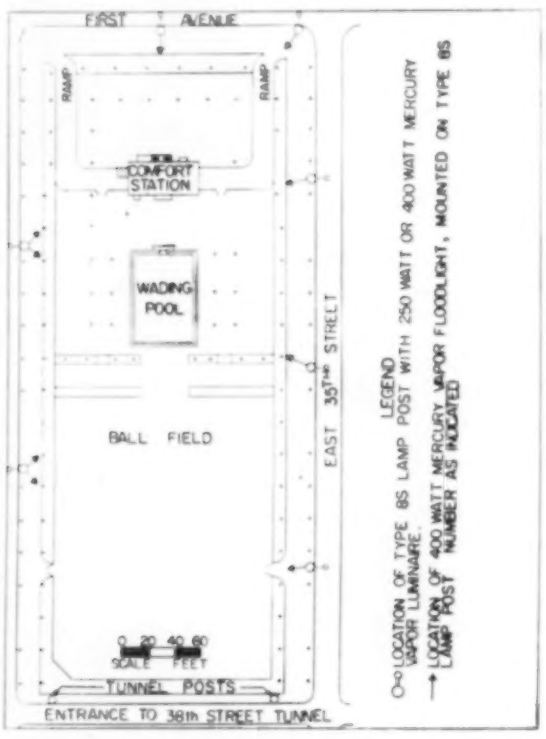

FIRST AVENUE
RAMP
RAMP
COMFORT STATION
WADING POOL
BALL FIELD
EAST 35TH STREET
0 20 40 60
SCALE FEET
TUNNEL POSTS
ENTRANCE TO 38th STREET TUNNEL
LEGEND
LOCATION OF TYPE 8S LAMP POST WITH 250 WATT OR 400 WATT MERCURY VAPOR LUMINAIRE.
LOCATION OF 400 WATT MERCURY VAPOR FLOODLIGHT, MOUNTED ON TYPE 8S LAMP POST NUMBER AS INDICATED

Figure 1. Typical standard playground.

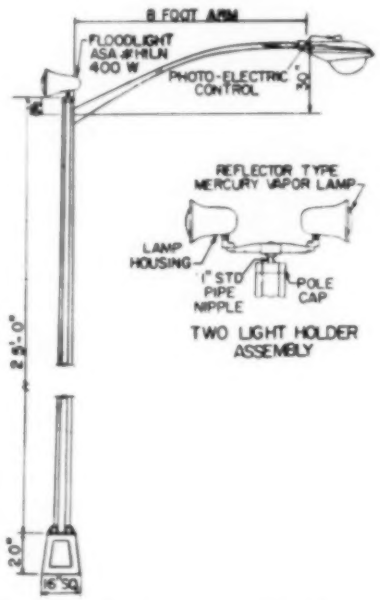


Figure 2. Type 8S steel lamp post with one or two floodlights.

ing luminaires, 400-watt or 250-watt integral ballast, were installed to step up the street illumination in the playground areas. Because the interior lighting had to be low, standard 230-watt incandescent park units, that would be located 90 feet apart, were chosen.

The total estimated cost of installation was $4,058,900. It was concluded that two possible installation procedures were possible. The procedure adopted required completion of all exterior lighting first. This could be completed in one year's time at a cost of $1,187,200. Interior lighting would follow, at an annual expenditure of $957,250. The actual cost per exterior unit with mercury luminaire and one floodlight is $417, and $533 where two floodlights are used. The average cost, including the street luminaire, is $3000 to $3800 per playground for exterior lighting where required, and $6000 to $9200 average cost for the interior lighting.

Results in the first stage of construction have been astounding. The Park Department has pointed to a drastic reduction in vandalism in the relighted playgrounds. The floodlighting diminished indiscriminate littering of playground areas with broken bottles, beer cans, etc. Better control and fewer instances of disciplinary problems have been reported. Also, fewer break-ins have occurred.

The exterior lighting has been so successful that upon reevaluating the program, it was decided to extend the program to spend $1,000,000 next year to provide exterior lighting for school playgrounds, and to install the interior system only in marginal playgrounds and in those playgrounds having considerable depth.

(Abstract of IES Conference Paper No. 21)

46 Comparisons of Recessed, Ceiling-Mounted and Suspended Office-Lighting Systems

C. L. Amick

R. D. Bradley

DESIGNERS and specifiers of modern office lighting systems face, continually, the problem of selecting appropriate lighting equipment. Esthetic, cost and comfort considerations are involved in determining: (1) whether luminaires should be recessed, ceiling-mounted or suspended; (2) the type, size and number of lamps to employ; and (3) the materials which should be utilized to achieve desired brightness control.

Architects and decorators are playing an increasingly greater role in choosing general types of illumination systems needed to fulfill broad esthetic objectives of the entire space. Recessed luminaires give uncluttered ceilings adaptable to reduced room heights. Surface-mounted units are widely chosen for similar reasons. Suspended models have broad application for economical and comfortable relighting, when designed to present low brightness in the normal field of view.

Initial, operating and total annual costs of typical recessed, ceiling-mounted and suspended 40-watt luminaires are given in Table I for a medium-sized general office (40 by 60 feet, with 10-foot ceiling height). The method proposed some years ago by Barr and Amick was employed. Of the prototypes studied, the direct-indirect suspended system with four rows of lamps per unit is lowest in initial and total annual cost. The wide range of economic results makes broad generalizations difficult. The lowest cost recessed system is somewhat more expensive than the most economical suspended and ceiling-mounted types, but the difference would often be considered small enough to permit wide latitude of choice for architects, designers and engineers in achieving desired spatial characteristics.

Since certain commercial-type fluorescent luminaires are available for lamps of various current ratings, the specifier has considerable choice in lamp selection. Fig. 1 shows installed and total

AUTHORS: Day-Brite Lighting, Inc., St. Louis, Mo.

Table I—Comparative Costs for Typical Recessed, Ceiling-Mounted and Suspended Luminaires

	LUMINAIRE TYPE	LAMP TYPE	INITIAL COST		ANNUAL OPERATING COST		TOTAL ANNUAL COST	
			DOLLARS	RANK*	DOLLARS	RANK*	DOLLARS	RANK*
RECESSED	Troffers with clear, ribbed-plastic enclosures							
	12-inch wide	Two 40w RS	3470	9	545	7	1030	8
	24-inch wide	Two 40w RS	3960	11	467	1	1045	9
	24-inch wide	Four 40w RS	2840	6	502	4	905	4
CEILING-MOUNTED	Plastic-enclosed (prismatic-bottom, diffusing sides)							
	10-inch wide	Two 40w RS	2670	5	557	8	945	5
	14-inch wide	Four 40w RS	2240	2	592	10	905	4
	Plastic-enclosed (Acrylic prismatic wrap-around)	Two 40w RS	4330	13	520	5	1170	10
	Double-wall diffusing Plastic sides and louvered bottom							
	16-inch wide	Two 40w RS	3740	10	650	11	1186	11
	24-inch wide	Four 40w RS	3100	7	568	9	1005	6
	Shallow, opaque-sided with clear, ribbed-plastic enclosure							
	12-inch wide	Two 40w RS	3340	8	545	7	1020	7
	23-inch wide	Four 40w RS	2350	3	487	2	820	2
SUSPENDED	Direct-Indirect with opaque sides and louvered bottom							
	13-inch wide	Two 40w RS	2500	4	537	6	893	3
	21-inch wide	Four 40w RS	2200	1	498	3	810	1
	Luminous indirect	Two 40w RS	4180	12	712	12	1310	12

*Rank among the luminaire prototypes included in the table.

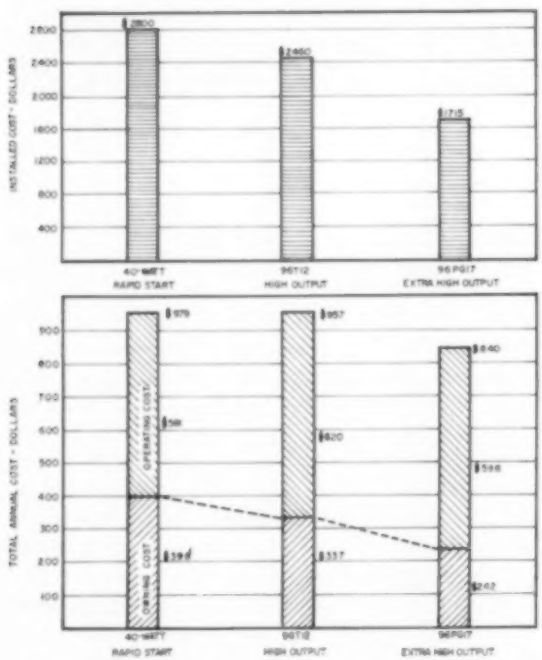


Figure 1. Installed and total annual costs for three different lamp outputs per foot.

annual costs for systems using a popular metal-sided, direct-indirect luminaire, having two rows of 430-, 800- and 1500-milliampere rapid-start fluorescent lamps. Initial and total annual costs are reduced as utilized light per luminaire dollar goes up, but again generalizations can be misleading. The brightness-control material in recessed and ceiling-mounted systems can have a major effect on the cost comparison. Two-foot wide troffers with four lamps are more economical than two-lamp, one-foot wide recessed units, and when the saving in acoustical tile is considered, the two-lamp, two-foot troffer offers cost as well as comfort advantages over two-lamp, one-foot recessed luminaires.

Visual comfort is considered to be of prime importance in office lighting, and lighting engineers should use glare-evaluation data automatically to insure customer satisfaction. The paper gives glare factors for 36 different luminaires, each installed in the assumed 40-by-60-by-10-foot room to give 100 footcandles minimum in service. A graph suggests appropriate comfort objectives for typical tasks, worker positions and degrees of visual concentration.

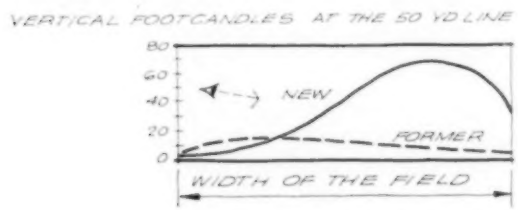
(Abstract of IES Conference Paper No. 46)

Left to right:

Ronald L. Paugh
David A. Toenjes
G. R. Baumgartner

20 Quartz Iodine Lamps and Football Field Lighting

THE QUARTZ IODINE lamp, because of its size and shape, offers extreme versatility for control of light. This characteristic seemed to suggest that a 1500-watt lamp in an appropriate luminaire design would be suitable for football field lighting.



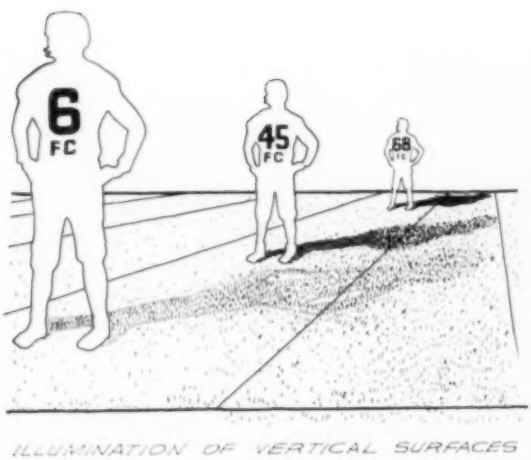


Figure 1. Graphical comparison of vertical light distribution for the former system and test installation. Effect of trial installation is to increase vertical illumination on players at greater distances from the spectators.

A trial installation of 64 specially designed units was set up on the football field at Brush High School, Lyndhurst, Ohio.

The school's former lighting system was a typical eight-pole arrangement, with the poles set at the 33-yard lines, 30 feet back from the side lines. General-service 105-volt incandescent lamps were operated at 110 per cent of rated voltage, in the eight standard floodlighting luminaires on each pole. After 15 years of service, this system was delivering an average horizontal illumination level of 7.9 footcandles.

In the new system 16 trial luminaires were mounted on only the four center poles, because twice as many higher-voltage lamps (240 volts) could be used on the existing conductors at each pole. Even with the lamps operating at only 95 per cent of rated voltage (the maximum available on existing circuits) an average horizontal illumination level of 17.6 footcandles was obtained. Since

AUTHORS: Large Lamp Department, General Electric Co., Nela Park, Cleveland, Ohio.

Figure 2. Night photograph showing the shadow effects of the system, and the increase in vertical brightness with distance across the field.

spectator visibility is dependent upon illumination of vertical surfaces, at all points on the field, most of the test luminaires using narrow beam spread were aimed well across the field. As a result, the vertical illumination upon a player increases as he moves away from the spectator. Calculations showed that this trial lighting system provided nearly constant spectator visibility, all the way across the playing field. With a typical conventional lighting system, designed to deliver equivalent horizontal illumination, vertical surface visibility to the spectator varies by a ratio of 3.4/1 from the near to the far side of the field.

(Abstract of IES Conference Paper No. 20)

22 Lighting Apple Packing Areas

Marvin E. Heft, Jr.

Dennis E. Wiant

THE PROBLEM of illumination for grading apples is to determine the proper, commonly available luminant that will maximize the contrast between the defect and the normal surface.

Spectral reflectance curves were obtained with a Beckman spectrophotometer, for 12 normal apple-surfaces, ten for green (a defect) surfaces, and six for other defective surfaces. The average readings of the normal and of the green surfaces were used for all calculations (Fig. 1). To determine the usable curve for the defective surface, the maximum reading of the six defects was used, as it was desired to investigate the effects of all surface defects. The resulting curve was called the maximum defect surface.

The next step was to convert the spectral reflectance to curves as seen by the human eye. This was done by multiplying the per cent relative sensitivity of the eye by the average spectral reflectance of the desired apple surface. The resulting curve was called the visibility function.

The illumination for apple packing areas must be such that it maximizes the contrast between the surface reflectance of the desired surface and the defects. Since there are two types of defective surfaces, it was necessary to evaluate the relative merits of the two contrasts. The contrast data are the mathematical difference between the visibility function of the two surfaces under consideration and is related to a common value. The least contrast occurs between the normal red surface and the maximum defective surface. Therefore, the luminant should favor this contrast.

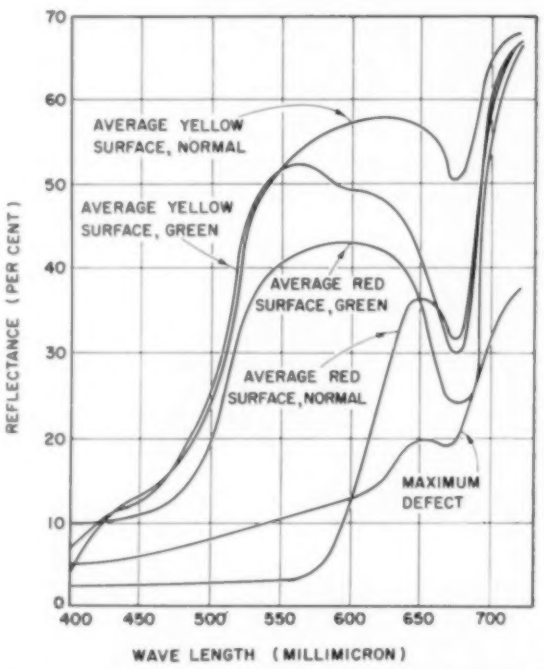


Figure 1. Average spectral reflectance curves for average normal and green apple surfaces and their maximum defects.

AUTHORS: College of Agriculture, Department of Agricultural Engineering, Michigan State University, East Lansing, Mich.

A luminant that emits energy throughout the entire visible spectrum and is rich in the area of the maximum contrast will give the maximum luminous flux in the desired area. The maximum luminous flux results when the coefficient of correlation for a two-variable correlation is a maximum. The highest coefficient of correlation among the commonly available lamps for the red surface-maximum defect contrast was 0.96, obtained with the deluxe cool white fluorescent lamp. Observational investigations in the laboratory with commonly available lamps verified the theoretical determinations.

The recommended level of illumination requires 20 footlamberts of surface brightness to obtain 90 per cent ability to see contrast, and 25 footlamberts to obtain 80 per cent of the maximum visual acuity. The surface brightness was 23.4 per cent when determined by the surface brightness formula. The average for the red and green surfaces was used since grade laws set a minimum of 50 per cent normal red surface for the top grades. One hundred seventy-eight footcandles of illumination are required in order to obtain 25 footlamberts when a service factor of 60 per cent is introduced.

Trial installations in apple packing plants confirmed the theoretical determination. Plant owners were unanimous in the selection of the deluxe cool white fluorescent lamp.

(Abstract of IES Conference Paper No. 22)

37 Convective Transfer of Lighting Heat Loads

R. D. Bradley

M. L. Quin

ARCHITECTS, engineers and building owners are finding that a thermal barrier to desired illumination levels exists because of the increases in refrigeration plant tonnage and air-handling systems required by lighting recommendations. The impact of heat loads produced by increasing footcandle levels—from 50 to 200, for example—has been such that the words lighting and heating become increasingly synonymous, until the lighting system becomes a dominant factor in cooling-load calculations.

Although recessed fluorescent troffers are widely used in large office buildings, special allowance for a reduction in the instantaneous rate of heat gain below the ceiling has not been fully investigated. Consequently, many cooling-load calculations assume the need for offsetting total energy in terms of rated wattage. The effect of footcandle increases upon "all-air" systems is shown in Fig. 1, wherein air-handling systems must increase at a greater rate than refrigeration plant tonnage.

The actual distribution of total energy, radiant, convected and conducted, is of fundamental importance to any evaluation of lighting, heating and cooling systems. In a series of calculations, the authors use a thermal factor to show the effect of energy distribution changes upon cooling-load calculations for an interior space illuminated to 200 footcandles with recessed troffers.

Method I: Refrigeration plant tonnage and cooling capacity requirements assuming total distribution of energy within the occupied space.

Method II: Changes in cooling capacity requirements resulting from experimental data on proportional distribution of energy into the occupied space.

Method III: Changes in refrigeration plant tonnage and cooling capacity resulting from experimental data on the further redistribution of energy

AUTHORS: Day-Brite Lighting, Inc., St. Louis, Mo.

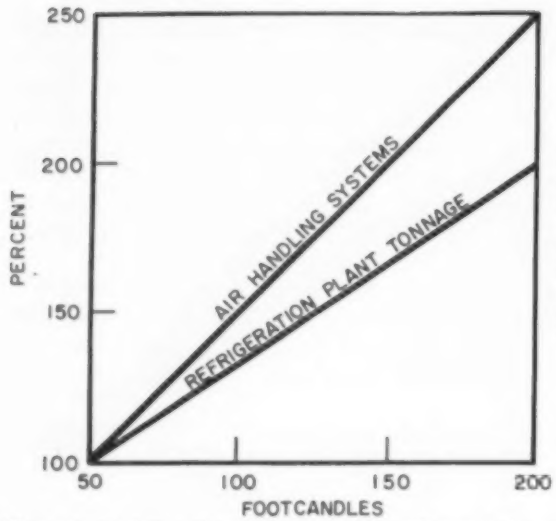


Figure 1. As footcandles increase, refrigeration and air-handling systems increase in cost. Based on standard means, air-handling increases faster than refrigeration.

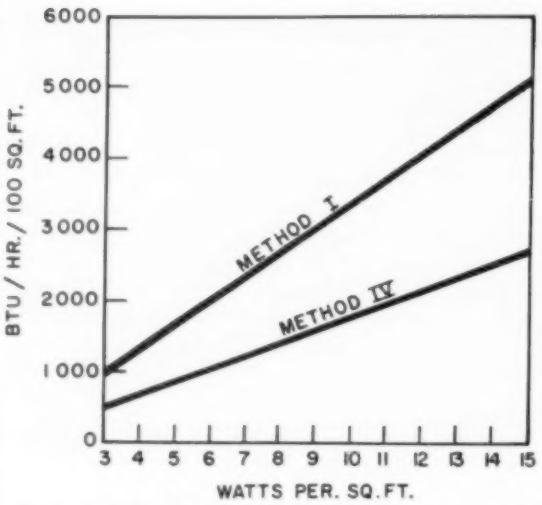


Figure 2. Effect of applying mechanisms of convective and radiant heat transfer in terms of total watts per square foot and heat gain in the occupied space.

by means of convective heat transfer with return air flow through troffers.

Method IV: Changes in refrigeration plant tonnage and cooling capacity resulting from experimental data on the further redistribution of energy by combining the mechanisms of convective and radiant heat transfer.

The comparative differences which may be expected between Methods I and IV are illustrated in Fig. 2. While refrigeration plant tonnage is not reduced, convective heat transfer can substantially reduce the lighting heat gain in occupied spaces. For seasonal requirements, the transferred heat may then be dissipated or utilized within the building by heat pump installations.

(Abstract of IES Conference Paper No. 37)

Left to right:

R. T. Dorsey
Alston Rodgers
W. D. Riddle

44 Design Considerations in A Small, Multi-Use Auditorium

In today's gregarious society, the widespread need for suitable meeting places results in a great demand for small auditoriums and meeting halls adaptable to a wide variety of uses. It is the purpose of this paper to discuss some of the desirable features and design considerations in planning and lighting such a small auditorium with facilities for various kinds of meetings and presentations. This installation (Fig. 1), employing several new types of light sources, materials and equipment, demonstrates a wide variety of techniques and achieves some interesting solutions to the problems encountered.

Authors: Large Lamp Department, General Electric Co., Nela Park, Cleveland, Ohio.

Figure 1. General view of auditorium.

Figure 2. Stage presentation with side projection-screen.

To increase adaptability and achieve a less formal appearance, the stage is moved off-center to the right and a large architectural element, in the form of a luminous grillework screen, placed at the left. The mobile-color screen becomes a focal point for a myriad of different visual moods and environments. In conjunction with stage demonstrations and talks, it can be converted instantly into a side-stage projection screen (Fig. 2). Separate lighting systems are provided to accent the ceiling, side walls, seating area and front curtain in this auditorium.

For general lighting, the designers decided to explore what might be accomplished by applying some of the modern structural techniques, such as the "geodesic dome" and the "space frame," to the architectural and lighting treatment of such an area. The result was the interesting "space frame" general lighting structure. In effect, this is a large lighting fixture composed of a self-supporting network of specially-designed wiring channels, spanning the room from wall to wall and supporting indirect-lighting troughs containing several different lighting circuits and techniques. For an interesting decorative effect, baffled downlights are positioned at regular intervals to cast shadows of the space frame on the walls.

Arrangement of the stage lighting for this auditorium is shown in Fig. 3.

Instead of the usual pulpit-like speakers' stand,

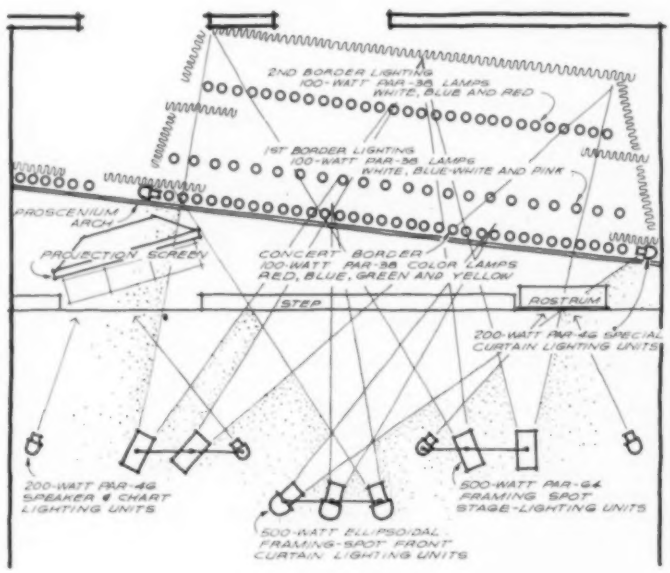


Figure 3. Stage lighting arrangement.
Scale ⅛ inch = 2 feet.

the rostrum is designed with the more informal appearance of a modern aluminum and wood table, with plenty of room for papers and notes, hand props, glasses and water carafe. Also included in the rostrum are a built-in clock, switched convenience outlets and a push-button lantern slide signal on cord and reel.

(Abstract of IES Conference Paper No. 44)

5 Stroboscopic Effect of Mercury Lamps With Various Ballasts and Circuits

W. S. Till

G. A. Horton

AUTHORS: Westinghouse Electric Corp., Lighting Division, Bloomfield, N. J., respectively.

Is STROBOSCOPIC effect an important factor in the design of lighting installations using mercury lamps? This question arises perennially, despite the fact that, to the authors' knowledge, stroboscopic effect has been more an imaginary than a real problem with mercury lamps operated on 60-cycle frequency. As past literature made no reference to a relative numerical evaluation for mercury lamps of current domestic design, this investigation was undertaken, along the lines followed by Eastman and Campbell[1] in their study of the flicker index of fluorescent lamps, with the purpose of obtaining similar information for mercury lamps.

Flicker index is considered to be a useful means

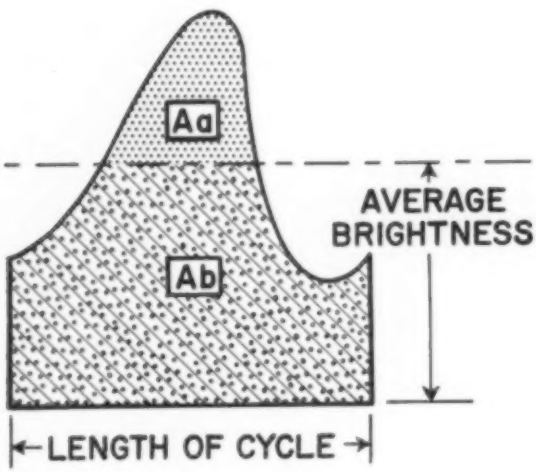


Figure 1. Flicker Index $= \frac{Aa}{Aa + Ab}$, **where** *Aa* **equals area above line of average brightness and** *Ab* **equals area under line of average brightness.**

Table I—Flicker Index for Various Lamps under Different Conditions of Operation.

TYPE OF CIRCUIT AND BALLAST	NO. OF LAMPS	LAMP TYPE AND FLICKER INDEX H33-I-CD (CLEAR)	H33-IGL/W ("WHITE")	H33-IGL/C (IMPROVED COLOR)
60c, 1 ϕ Standard Reactor	1	0.235	0.229	0.198
60c, 1 ϕ Regulated Output	1	0.196	0.184	0.177
60c, 1 ϕ Lead-lag	2	0.136	0.130	0.123
60c, 3 ϕ High p.f. (commercial) Reactor	3	0.027	0.026	0.024
60c, 1 ϕ Series Reactor	1	40-watt standard cool white fluorescent 0.111		
60c, 1 ϕ	1	40-watt standard cool white 0.043		

of evaluating stroboscopic effect. It can be calculated from oscillograms of light output wave forms (see Fig. 1). The apparatus used for the study of light output wave form included a vacuum-type phototube with filter for approximate correction to the average eye-sensitivity curve, a cathode-follower type of d-c current amplifier, and a cathode-ray type of oscillograph.

Flicker index can range from zero to one, with the zero value having no flicker. Table I lists the flicker indices that the authors have calculated for various combinations of lamps and ballasts. In addition to the data for various mercury lamps, which include several sizes and color types, data are given for a 40-watt incandescent lamp and a 40-watt standard cool white fluorescent lamp.

The effective flicker index of mercury lamps, operated on separate phases of a three-phase system with commercially available ballasts, is less than that of a 40-watt incandescent lamp operated on single phase or a 40-watt standard cool white (preheat) fluorescent lamp operated on single phase with a series reactor ballast. With three-phase operation, mercury lamps have been successfully used even where extremely fast motion was involved, as in jai alai courts and machine shops. Mercury lamps operated with lead-lag ballasts have only slightly higher flicker indices than the fluorescent system.

Mercury-fluorescent (phosphor-coated) lamps have slightly less flicker than clear mercury lamps. Of the two principal phosphor-coated types, the improved-color types such as H33-1GL/C have less flicker than the "white" color-modified types such as H33-1GL/W. In general, the differences are small, and it can be said that the ballast or circuit makes much more difference in stroboscopic effect than the lamp.

So far as cost of light is concerned, studies show that three-phase mercury lamp installations can cost less than single-phase systems. Lead-lag single-phase systems can cost less than reactor single-phase installations.

Reference

1. Eastman, A. A. and Campbell, J. H.: "Stroboscopic and Flicker Effects from Fluorescent Lamps," ILLUMINATING ENGINEERING, Vol. XLVII, p. 27 (January 1952).

(Abstract of IES Conference Paper No. 5.)

47 Fluorescent Lamps and Commercial Applications

K. H. Thompson

R. N. Edwards, Jr.

WITH THE NEW RECOMMENDED illumination levels of the Illuminating Engineering Society, there is a natural desire to utilize the high-output (800-ma) and the extra-high output (1500-ma) fluorescent lamps in commercially available luminaires. Experience, to date, with industrial luminaires has proven these lamps to be economically sound and reliable sources of illumination, but little is known concerning their performance in luminaires which are designed for office, school and store applications.

One purpose of the study described in this paper was to determine how luminaire efficiency is affected if luminaires designed for 430-ma lamps are operated with 800-ma and 1500-ma lamps. Table I lists and describes the luminaires and the areas considered in this paper. Fig. 1 is a plot of luminaire efficiency *vs.* fluorescent lamp current for Table I. Row spacing, average brightness, economics, and ballast noise and heat are also given consideration.

AUTHORS: Westinghouse Electric Corp., Lighting Division, Cleveland, Ohio.

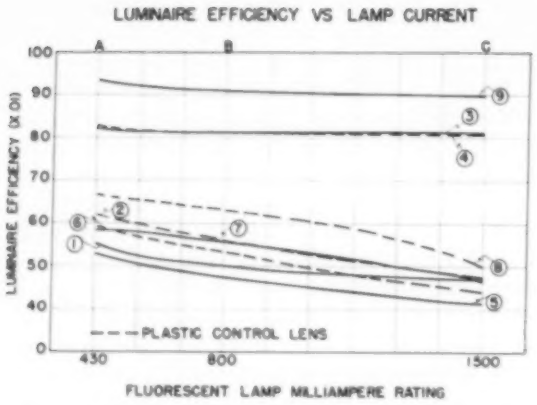


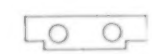
Figure 1. Plot of luminaire efficiency vs lamp current for the test data listed in Table I and luminaires as described in Table I.

Generally, 425-430-ma lamps are still the most practicable for the present range of recommended illumination levels. In certain instances, an economic advantage is obtained for higher loaded lamps; however, economy should never be the sole criterion for selecting the luminaire. In most cases, the use of higher loaded lamps imposes a substantial increase in luminaire average brightness, compounding an already marginal condition.

Although a limited number of commercial luminaires utilizing extra-high-output lamps are available at present, the 1500-ma lamp seems destined for use with the integration of lighting, air conditioning, and acoustical elements. This is perhaps as it should be!

(Abstract of IES Conference Paper No. 47)

Table I—Commercial Fluorescent Luminaires for Application in School, Office, and Store Areas

APPLICATION	SYMBOL	DESCRIPTION	SKETCH
Office 50′ width 100′ length 9′ ceiling	1	Recessed mounted 2′ x 4′ luminaire with four, four-foot fluorescent lamps and plastic 45° x 45° louver. Depth 5″ over-all.	
	2	Recessed mounted 2′ x 4′ luminaire with four, four-foot fluorescent lamps and plastic control lens. Depth 5″ over-all.	
Classroom 25′ width 30′ length 9′ ceiling	3	Suspension mounted (12″ hanger) luminaire with two, four-foot fluorescent lamps and 35° x 45° metal louver. Width 13″, depth 5″ over-all.	
	4	Suspension mounted (12″ hanger) luminaire with two, four-foot fluorescent lamps and plastic control lens in place of louver blades beneath each lamp. Width 13″, depth 5″ over-all.	
Office 50′ width 100′ length 9′ ceiling	5	Recessed mounted 1′ x 4′ luminaire with two, four-foot fluorescent lamps and plastic 45° x 45° louver. Depth 5″ over-all.	
	6	Recessed mounted 1′ x 4′ luminaire with two, four-foot fluorescent lamps and plastic control lens. Depth 5″ over-all.	
Office 50′ width 100′ length 9′ ceiling	7	Surface mounted luminaire with two, four-foot fluorescent lamps and plastic 45° x 45° louver. Depth 3⅝″ over-all, width 16¾″.	
	8	Surface mounted luminaire with two, four-foot fluorescent lamps and plastic control lens. Depth 3⅝″ over-all, width 16¾″.	
Store 60′ width 100′ length 12′ ceiling	9	Surface-mounted luminaire with two, four-foot fluorescent lamps having no shielding. Width 4⅝″, depth 4″ over-all.	
All	2-	Denotes eight-foot lamps in eight-foot luminaire only.	All
All Above	A	4-foot 430-ma T12 fluorescent lamp rated 2800 lumens. (8-foot lamp is 425 ma T12 rated 5600 lumens.)	
All Above	B	4-foot 800-ma T12 fluorescent lamp rated 3850 lumens. (8-foot lamp is 800 ma T12 rated 9000 lumens.)	
All Above	C	4-foot 1500-ma T12 fluorescent lamp rated 6900 lumens. (8-foot lamp is 1500 ma T12 rated 15,000 lumens.)	

INSTALLATION AT
FIRST CONGREGATIONAL CHURCH
1634 WASHINGTON AVE., S. E.
CEDAR RAPIDS, IOWA

Floodlighting a Steeple

LIGHTING OBJECTIVE: To floodlight a church tower and spire to produce a beautiful and striking nighttime appearance.

GENERAL INFORMATION: This church is in a residential area where both the tower and spire can be seen from a distance. The floodlighted portion of the tower is white (85 per cent reflectance). It is about 25 feet tall with its base 35 feet above ground. The spire, which is weathered copper (8 per cent reflectance) also is 25 feet tall.

INSTALLATION: Twenty Magni-Flood, Inc. catalog No. R luminaires, each equipped with one 150-watt PAR-38 flood lamp, are installed on the ledges below each steeple section: two luminaires on each side of the two tower sections and one on each side of the spire section. They are aimed upward and slightly in toward the surface to be floodlighted.

The average level on the tower is 30 footcandles. Brightnesses vary from 13 to 38 footlamberts on the tower surface and 1 to 2 footlamberts on the spire.

All tower luminaires are easily accessible for maintenance from the exterior. The four spire luminaires are accessible from the interior of the tower by means of doors cut in the bottom of the spire section.

Lighting designed by Edwin H. Ford, Iowa Electric Light and Power Co., Cedar Rapids, Iowa.

Lighting data submitted by Edwin H. Ford as an illustration of good lighting practice and to aid in the design of similar installations.

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Series XXVI
9-61

A.I.A. File No. 31 f

Architectural student winners of Allied Arts Competitions display prize-winning designs. From University of Cincinnati (photo above), in contest sponsored by Miami Valley Section, l. to r.: Frank A. Mallalieu, third prize; Frank H. Roberts and James A. Fox, second; Bernard J. Wulff, first. In photo at right, Arizona State University winners in Arizona Section's contest, l. to r.: Thomas Potter, third; Cooper Downs, second; Gerald Lunkeen, first. At far right is John Jakob, assistant professor of architecture. Winning designs from Allied Arts contests throughout the country will be on display at the IES National Technical Conference in St. Louis.

Pittsburgh Section dinner-dance honored "native sons" who held IES national offices during 1960-1961, President Richard G. Slauer and East Central Regional Vice-President Carman D. Miller. At right, President and Mrs. Slauer accept gift from Section while Mrs. H. J. Mazur, wife of Pittsburgh's incoming chairman, looks on. Photo at far right, l. to r.: Chairman James B. McNall, Mrs. McNall, RVP Miller and Mrs. Miller.

1961-1962 Winnipeg Chapter Executive Committee, left to right: D. E. Macpherson, secretary-treasurer; J. D. Stephen, vice-chairman; E. T. Battle, immediate past chairman; Frank Dehod, chairman; J. M. Kerluke, A. A. Bertrand and K. L. Philp, board of managers.

LIGHTING NEWS

Three New Chapters Chartered Total Now 97

The recent chartering of three new IES Chapters, Gulfstream in Ft. Lauderdale, Fla.; Blue Ridge, Roanoke, Va.; and El Paso International, El Paso, Texas; brings the number of IES local groups to 97. Gulfstream (No. 95) and Blue Ridge (No. 96) were chartered at the June 7th meeting of Council; El Paso (No. 97) was accepted for membership at the August 4th Council Executive Committee meeting.

Gulfstream Chapter, Southeastern Region was organized in 1959, under the sponsorship of the Southeast Florida Section, as the Ft. Lauderdale Study Club. Its territory was formerly part of the Southeast Florida Section. Charter officers of the Chapter included: chairman, Thomas C. Kendrick, Jr.; vice-chairman, Charles E. Bailey; secretary-treasurer, Ervin Y. Eaker; board of managers, Charles J. Minnet, Albert F. Anderson and Walter A. Furst. For 1961-1962, Robert B. Mills will serve as chairman; Alison Sloan, vice-chairman; E. Y. Eaker, secretary-treasurer; John Potter, Ken Vincent and William Nash, members of the board of managers. Installation of these new officers and charter presentation ceremonies were held on September 9 at the Space Satellite Hotel, Pompano Beach, Fla.

Blue Ridge Chapter, East Central Region, is located in the western part of Virginia, in territory formerly under the auspices of the Virginia Section. John C. Manos has been elected first chairman of the group; J. W. Wall, vice-chairman; W. A. Sowers, secretary-treasurer; W. A. Mitchell, Walker Graves and Andrew L. Graham, Jr., board of managers.

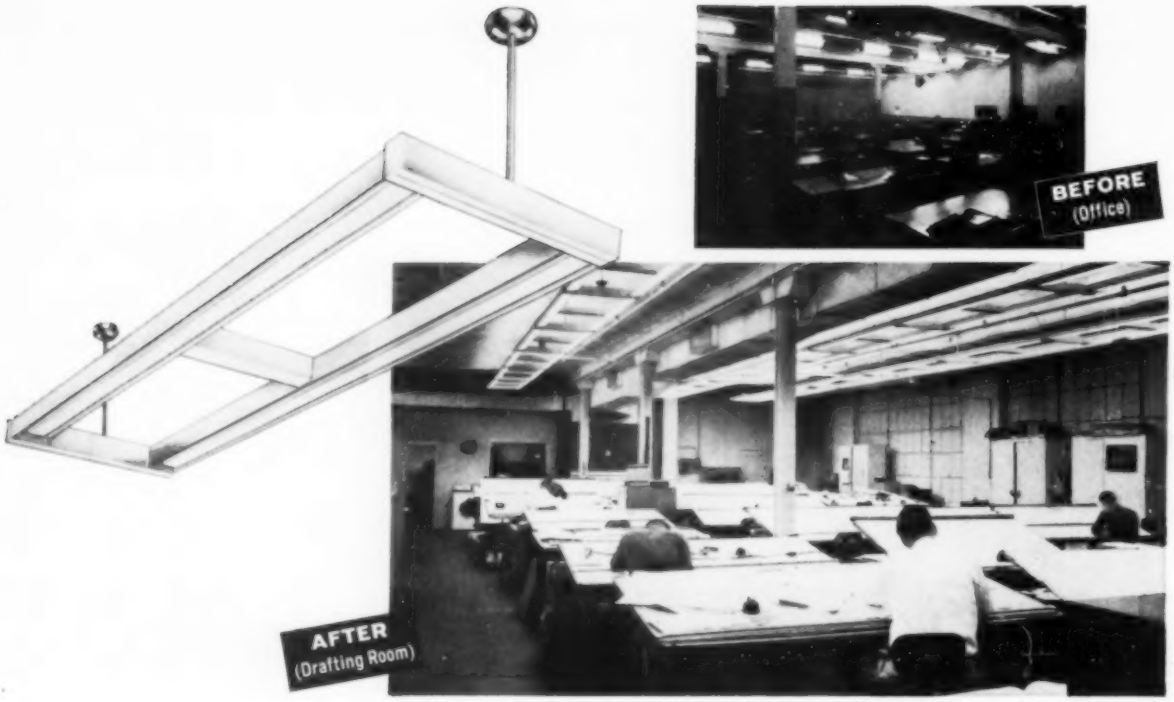
El Paso Chapter, located in southern New Mexico and the extreme western part of Texas, is in the Inter-Mountain Region. Organized as a study club in January 1960, the group held six meetings prior to charter application. Mrs. Vivian Hamilton has been named charter chairman; Harold Pollard, vice-chairman; Joseph Glavy, secretary-treasurer; John Marczeski, Kenneth Brown and Dan Smith, members of the board of managers.

IES Headquarters Now Located in United Engineering Center

On August 30, IES Headquarters offices were officially installed on the ninth floor of the new 20-story United Engineering Center, 345 East 47th Street, at United Nations Plaza in New York City. IES shares tenancy of the building (shown in final stages of construction below) with the headquarters of 18 other engineering societies and organizations, including The Engineering Societies Library.

The new building features, in addition to office space, a 6,234 square foot main floor exhibit area, a 450-seat auditorium, meeting rooms, employee cafeteria and private dining rooms. The Center is owned and operated by the United Engineering Trustees, Inc., and is being financed by contributions from the occupying societies. Formal dedication is planned for November 9.

A complete illustrated story on the IES offices, including details of the luminous ceiling designed to meet recommended practice for office lighting, will appear in the October issue.



Sylvania's HQ Fixture
provides
NORGE Division
of Borg-Warner
QUALITY Lighting
ECONOMICALLY

The Norge Division of Borg-Warner Corporation in Effingham, Illinois, faced a common problem. They wanted better lighting in their office and drafting room . . . to eliminate shadows and glare . . . to make seeing easier . . . to enable engineers to perform their critical work without cumbersome auxiliary lighting equipment. And they wanted this new illumination system at reasonable cost.

The happy solution—Sylvania's HQ Series fixtures using 1500 ma (VHO) lamps, together with a newly-painted ceiling area. These indirect fixtures with 75% upward component provide 120 footcandles (measured) of well-diffused quality illumination. Glare and shadows are non-existent. The need for supplementary lighting equipment has been eliminated.

Sylvania's fixtures met the final requirement, too. This system of HQ Fixtures cost considerably less than other systems that had been suggested.

The installation at Norge is another example of how, with Sylvania Fixtures, you can choose the lighting fixtures that fit the requirements of *your* job. No *one* fixture meets the requirements of *all* installations. But with Sylvania's fixture line, you can choose the lighting that fits your needs best. And you'll get top-flight performance from every one.

When you want better lighting . . . look into the many advantages that Sylvania offers.

SYLVANIA LIGHTING PRODUCTS
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SYLVANIA

SUBSIDIARY OF
GENERAL TELEPHONE & ELECTRONICS

GENERAL SYSTEM

IES Elects Eight New Fellows

In recognition of their notable contributions to the science and art of illumination, the following have been elected Fellows of the Illuminating Engineering Society

H. E. D'Andrade, New York Section
Architects' and Engineers' Advisor, Large Lamp Department, General Electric Co., New York, N. Y.

A leading figure in the integration of lighting and architecture, credited with many pioneering installations, Mr. D'Andrade has worked closely with architects and consulting engineers in developing applications for new types of lamps. Among his installation "firsts" are the small aperture downlight, commercial use of the fluorescent lamp in New York, instant-start and low brightness fluorescent lamps. His eminence in his field won him a major role in the development and subsequent revisions of the light and architecture section of the *IES Lighting Handbook*.

His numerous IES activities include long service on the General Board of Examiners, with two years as chairman (1958-1960); membership on the Hotel and Central Station Properties Subcommittees and official IES representative to the American Standards Association Committee on Building Exit Codes.

Grant E. Davidson, Toronto Section
Supervising Illumination Engineer, Ontario Hydro-Electric Power Commission, Toronto, Ont.

Responsible for much valuable work in the evaluation of the performance of light sources and luminaires and the science of illumination measurement, Mr. Davidson is perhaps the leading Canadian authority on photometry. He has long been an active member of the IES Light Sources and Testing Procedures Committees and has served on almost all subcommittees of the Testing Procedures Committee.

A member of the Canadian National Committee of CIE, Mr. Davidson has received international recognition of his proficiency in the form of appointments to five CIE Committees of Experts. In addition he has served on the Canadian Standards Association committees on incandescent lamps and office lighting and is chairman of the Ontario Hydro-Electric research panel on illumination materials.

Arthur A. Eastman, Cleveland Section
Visual Research Engineer, Radiant Energy Effects Laboratory, General Electric Co., Cleveland, Ohio.

Mr. Eastman's research into the relationships between light, vision and seeing have resulted in several important contributions to instrumentation and advanced measurement techniques in optics and illumination. He participated in development of the Luckiesh-Moss visibility meter, designed the small spot reflectometer, and aided in the development of the visual task evaluation technique used in the Blackwell research on lighting levels.

His work on visibility in such areas as lighting for critical seeing, lighting for older workers, blink rate and ease of seeing, flicker effect of fluorescent lamps and brightness differences in suprathreshold seeing have been instrumental in leading to the acceptance of higher lighting levels. For these researches and the development of a new astigmatic test chart, Mr. Eastman was elected a Fellow of the American Academy of Optometry.

George E. Inman, Cleveland Section
Manager, Advance Discharge Lamp Engineering (Retired), Large Lamp Department, General Electric Co., Cleveland, Ohio.

An outstanding inventor, holder of approximately 30 patents in the field of light sources, Mr. Inman is regarded as one of the primary developers of the fluorescent lamp. As director of a group of engineers who worked on a practical low voltage fluorescent source, he authored the first paper on fluorescent lamps ever presented at an IES National Technical Conference (1935). He also holds the basic patent on the fluorescent source, which was issued in 1941.

Mr. Inman also made substantial contributions to the development of the high pressure xenon flash lamps used during World War II, the instant-start, rapid-start and 1500-ma fluorescent lamps, was active in the high-pressure mercury field and, most recently, was associated with the development of a newly introduced panel fluorescent source.

Newly Elected IES Fellows (Continued)

Merle E. Keck, Cleveland Section
Manager, Outdoor Lighting Engineering Section
Westinghouse Electric Corp., Cleveland, Ohio.

As a street and floodlighting engineer, Mr. Keck has won the esteem of his colleagues for his original contributions—the introduction of the coefficient of beam utilization into floodlighting calculations, a method for determining the correct positioning of directionally adjustable luminaires to produce desired lighting results with overlapping beam patterns, and a method of angling floodlight crossarms for better utilization of light and less glare. He is also the inventor of several devices which improve the mechanical performance of street lighting luminaires, and an optical system designed for highway lighting.

Mr. Keck has contributed much time and knowledge to the IES Sports and Roadway Committees, including two years as chairman of the Sports and Recreational Areas Committee. He is the author of five technical papers presented at IES National Conferences.

Herbert A. Kliegl, New York Section
President, Kliegl Brothers, Universal Electric Stage Lighting Co., New York, N. Y.

A resourceful inventor, recognized as a major force in the progress of theatrical, television and special effects lighting, Mr. Kliegl developed or participated in the development of much of the equipment currently in use in these fields, among them the ellipsoidal reflector, Fresnel lens spotlight, spot and downlights, lens striplights, silicon rectifier dimmer, and cold patching circuit connection system of the cord and plug type.

As initiating chairman of the IES Television Committee, he guided the preparation of four technical reports. He also served as IES representative to the Society of Motion Picture and Television Engineers and as a member of several CIE expert committees.

Applyng his talents to other activities, Mr. Kliegl has won distinction for the development of lighting systems for military use and for work in employee-management relations.

Karl A. Staley, Cleveland Section
Specialist, Personnel and Sales Training, Large Lamp Department, General Electric Co., Cleveland, Ohio.

A technical writer of high repute, author of numerous books, pamphlets and articles on illumination, including a widely esteemed publication on the fundamentals of lamps and lighting, Mr. Staley is one of the foremost "educators" in illuminating engineering. His leadership in establishing and implementing the IES Allied Arts program for architectural students and fostering the incorporation of lighting courses into the curricula of many architectural schools have won him great esteem from his architectural colleagues.

His role in the development of lighting training programs and as a lecturer on lighting at several universities further attest to his eminence as an educator. In addition, he is an accomplished application engineer, having spent almost 20 years in that capacity.

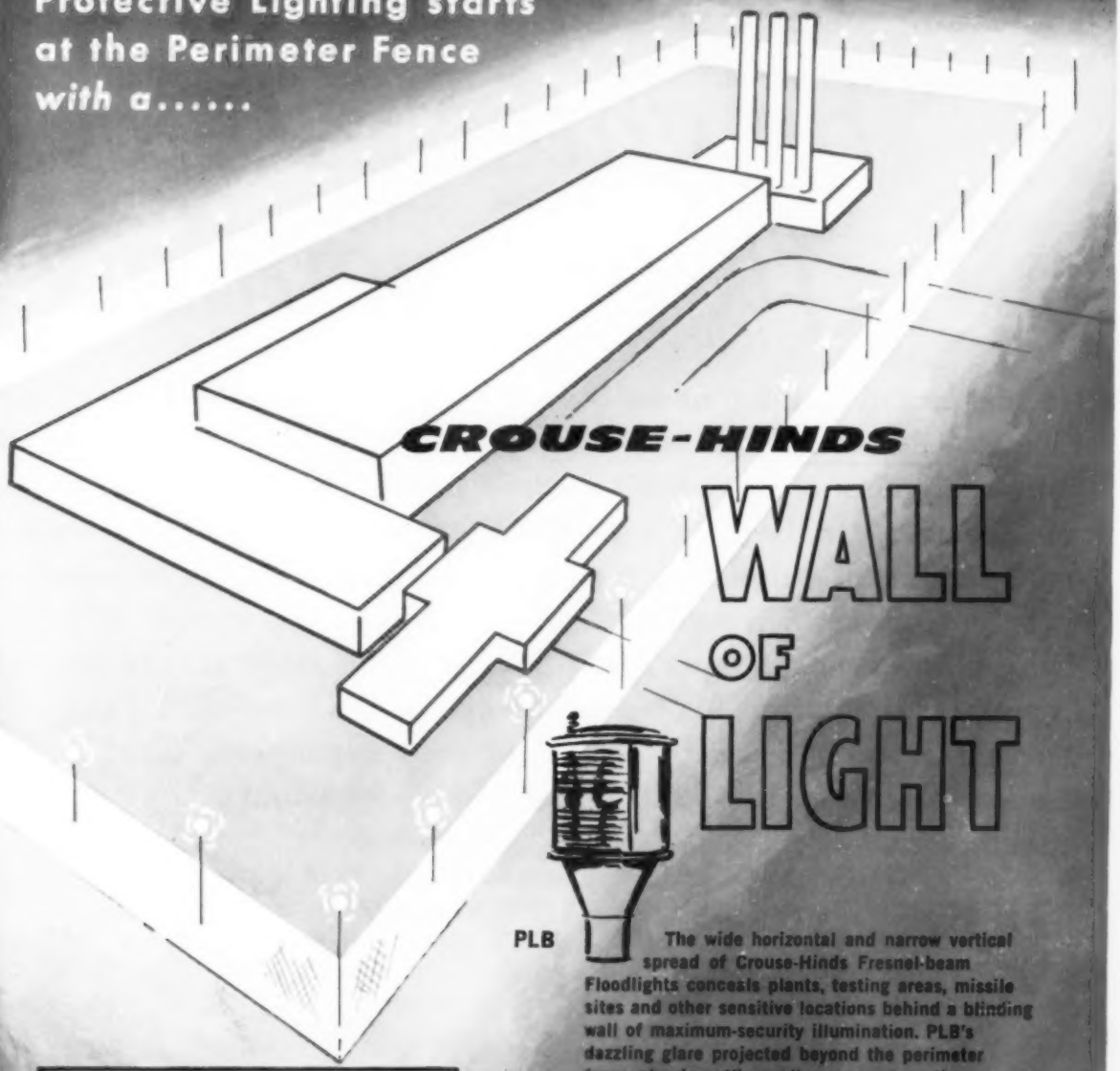
Arthur W. Weeks, New England Section
Engineer in Charge of Fluorescent Testing, Champion Lamp Works, Lynn, Mass.

A leader in the field of fluorescent lamp measurements, Mr. Weeks has made substantial contributions to photometric instrumentation and laboratory techniques. As chairman of the IES Testing Procedures Committee from 1955 to 1957 and again from 1958 to present, he spearheaded the development of the "IES Guide for Fluorescent Lamp Measurements."

He has co-authored several papers on electric shock and injury which have become the basis of industrial safety standards, and was one of three authors of a United States paper on the electrical measurements of fluorescent lamps presented to the 1955 CIE Congress. In addition to his activities on the IES Testing Procedures and Light Sources Committees, Mr. Weeks is a member of five ASA committees on light sources and auxiliary equipment, and the CIE Photometry Committee. He is a registered professional engineer in Massachusetts.

(*News continued on page* 16A)

Protective Lighting starts at the Perimeter Fence with a.....



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PLB

The wide horizontal and narrow vertical spread of Crouse-Hinds Fresnel-beam Floodlights conceals plants, testing areas, missile sites and other sensitive locations behind a blinding wall of maximum-security illumination. PLB's dazzling glare projected beyond the perimeter fence clearly outlines all movement on the approaches, yet obscures guard, patrol and other activity on plant property.

Modified beams conform to land contours. No shadows. No blind spots. Multiple and series types afford economical current distribution for varying line lengths. A range of sizes, wattages and foot-candles satisfy all plant-geometry and topographical requirements.

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ADE and MVE Productive-Area Floodlights turn Nighttime into Day

Whether you need incandescent ADE or mercury-vapor MVE lights for your plant or building areas depends on hours of burning, relamping difficulties and labor costs. Whatever your requirements, wide or narrow beam, short or long range, Crouse-Hinds has a highly-efficient, heavy-duty projector especially for the job.

For detailed information call your Crouse-Hinds distributor or ask for Floodlight Catalog No. 2714.

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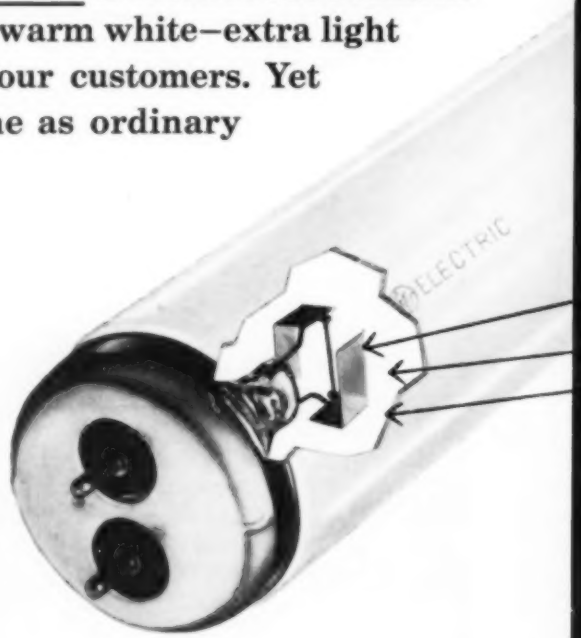
General Electric brightest 40-watt fluorescent ever

Here's money-saving news for 40-watt fluorescent users. General Electric's NEW F40 gives a 7% bonus in light at no extra cost. Now your customers can get their desired lighting level with fewer lamps and fixtures. Or they can increase their existing lighting level without spending a single extra penny for lamps, fixtures or electricity.

Only General Electric offers this bonus in standard 40-watt "white" fluorescent lamps. The G-E NEW F40 is rated at 3100 lumens in popular cool white, 3250 in white or warm white–extra light worth 15¢ to 30¢ a lamp to most of your customers. Yet the list price for this lamp is the same as ordinary fluorescents.



NEW F40 ONLY $1.30 LIST

announces the cool-white made...

The bonus of light your customers get with General Electric's *NEW F40* is made possible because of these G-E Premium 3 construction features:

1. **G-E wattage-miser electrode helps convert power ordinarily lost in the cathode into useful light—free.**
2. **New, more efficient gas mixture.**
3. **New electronically screened bonus-phosphor.**

And all these light producing features are available for the first time in a lamp that sells for the same price as ordinary fluorescents—only $1.30 for the popular cool white, $1.35 for other "white" colors.

Designed for both Rapid Start and starter-type circuits, the *NEW F40* has a life rating of 7500 hours for most circuits (6000 hours for systems installed before 1954). To get 7500-hour life in pre-'54 circuits, F40/54 lamps are available. They give the same light as ordinary 40-watt fluorescents (2900 lumens) and list for the same price ($1.30 in cool white). General Electric Co., Large Lamp Dept. C-122, Nela Park, Cleveland 12, Ohio.

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GENERAL ELECTRIC

Skull session, l. to r.: President Slauer; Ruby Redford, IE Editor; John Chorlton, Canadian RVP.

A memento of New Brunswick. President and Mrs. Slauer admire bird's-eye maple lazy susan.

As with other important IES Conferences, President Richard G. Slauer was a featured luncheon speaker.

Sixth Maritime Convention, Moncton, N. B., June 2-3

On the official record, IES throughout Canada and the United States holds nine Regional Conferences each year (see August IE, page 11A). Unofficially, however, there are *ten* Regional Conferences. So active are the group of members from the three Chapters in the Maritime Provinces in eastern Canada that their annual convention rates in every way as a major IES event.

This year's convention was their sixth, and as with the previous five, it was comparable in every phase to any of the official nine conferences. Seven excellent papers comprised their technical program. An especially practical panel discussion on Lighting Specifications featured five experts (see program below). Two luncheon sessions were presented, one of which featured IES President Richard G. Slauer as guest speaker. And, as with any successful conference, a good entertainment committee planned a special program for the ladies, a lobster picnic for all, and a smashing banquet and dance.

At the Brunswick Hotel in Moncton this year, the attendance reached 136—a remarkable 130 per cent of the area's total membership. Except for four national guests, the attendees were gathered essentially from the Maritime region, comprising the Northumberland Chapter in Moncton, the Maritime Chapter in St. John, N.B., and the Bluenose Chapter in Halifax, N.S. Some members came from as far as Newfoundland.

As can be seen from the program detailed below, the two-day meeting afforded Maritime members (and at least 34 guests) a valuable conference.

FRIDAY, JUNE 2

Address of Welcome—His Worship, Sherwood H. Rideout, Mayor of the City of Moncton.
Inspection Tour—Canadian National Railways Regional Hump Yard, C. Owen Lockhart, Commentator.
Jets Require Jet Lighting—M. J. McAuliffe, Canadian Westinghouse Corp.
Light Source Development—J. W. Bateman, Canadian General Electric Co.
Evening Social Program—boat sail, shore dinner and barn dance.

SATURDAY, JUNE 3

Local Activities Meeting—John M. Chorlton, Canadian Regional V-P, Chairman.
Church Lighting — Harry Gottlieb, Modulite Inc., Montreal.
Commercial Lighting—Arthur Jaeger, Corning Glass Works, Corning, N. Y.
Street Lighting—R. T. Somers, Powerlite Devices Ltd., Toronto.
President's Luncheon—Richard G. Slauer, IES President.
Panel Discussion — Are Specifications too Weak? Panelists: Douglas Leigh, Manufacturer; Alexander Moore, Consulting Engineer; H. C. Roberts, Supplier; Robert Story, Contractor; George C. Robinson, Moderator.
Residential Lighting—Hartley Schipper, Lite-Line Manufacturing Co., Toronto.
Reception—Bluenose and Maritime Chapters, Hosts. Banquet and Dance.

CREDITS

Convention Chairman—Max L. Higgs
Vice-Chairman—Lloyd W. Vincent
Secretary—J. D. Smith
Treasurer—Ben Lavigne
Program-Speakers—Murray A. Kincade
Entertainment—Sifroi LeBlanc
Publicity—Owen Lockhart
Reservations—Donald Shanks
Finance—Wilfred McElman
Ladies' Program—Vera McElman

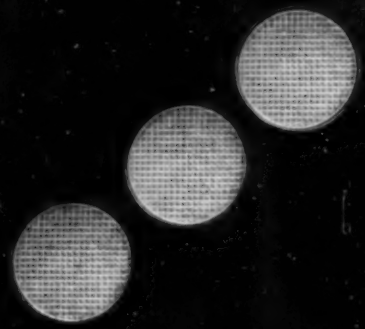
SESSSION CHAIRMEN

E. J. Wilcox—Maritime Chapter
E. Landriault—Bluenose Chapter
L. W. Vincent—Northumberland Chapter
G. C. Robinson—Maritime Chapter

(*News continued on page 20A*)

Incoming Chapter chairmen for Maritime area, l. to r.: Ed Wallace, Maritime; Frank O'Neill, Bluenose, Lloyd Nolan, Northumberland.

Nova Scotia lobsters at Shediac, N. B. A fun feature of the Maritime Conference was this informal lobster picnic and hoedown.



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in incandescent lighting

Glowing geometric shapes combine the beauty of soft satin handblown glass with all-aluminum construction to provide an unusual combination of decorative effects limited only by the imagination of the designer. ***light-forms*** can be used individually or in combinations of alignment to create patterns of light that become an integral part of the architecture.

Designed for wall use only, ***light-forms*** may be used on either interiors or exteriors.

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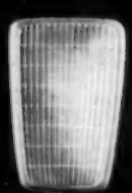

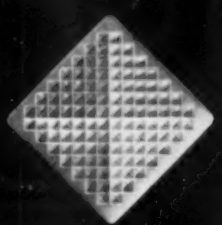

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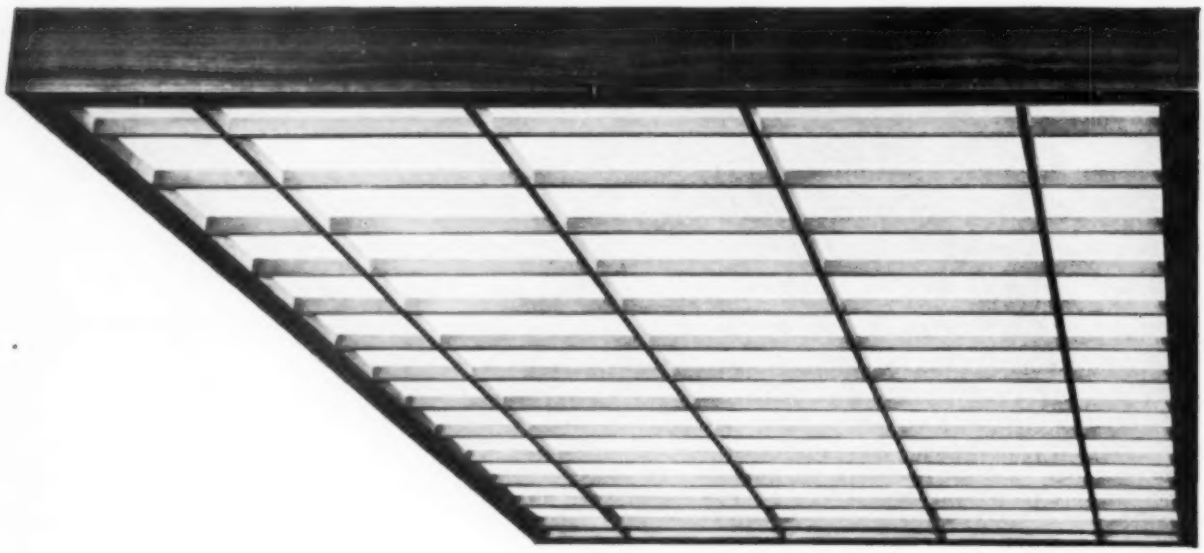
There's been a stunning metamorphosis in fluorescent lighting. To its efficiency, Lightolier has now added beauty to enhance both the fixture and its surroundings as well. Below: *Corona*, a shallow panel of light surrounded by a rich walnut frame and traced with handsome birch baffles. Its opposite number is *Coronet*, in many respects

STRIKING METAMORPHOSIS



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a twin, yet with a character all its own. It's made of steel...finished in enamel...shaped to present a finely sculptured appearance. Golden anodized aluminum louvers add a subtle luster. Broadly scaled for low brightness illumination, both fixtures are available either stem or surface mounted in five sizes: 54″x54″, 42″x42″, 30″x30″, 32″x54″, 16″x54″.

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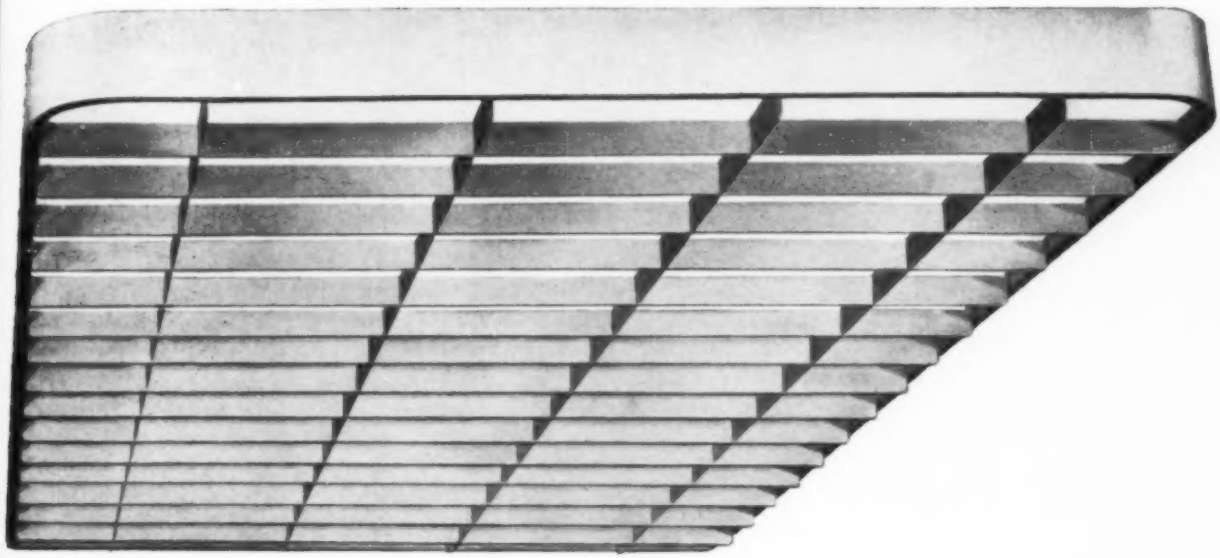

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Union Elec. Sup.

Installations in the News...

Self-Ballasted Mercury for Sign Lighting

This 90 foot long by 24-foot high sign located at the New Jersey approach to the Holland Tunnel (which links New York and New Jersey) is lighted by 1750-watt self-ballasted mercury lamps. The lamps are made of hard glass and used in inexpensive open-type fixtures which beam the light downward. Since no external ballasting is required, light-weight suspension arms are used for mounting. A 12 per cent red component (twice that of improved-color mercury lamps) provides good color rendition of the sign.

Similar lighting is used for a sign on the New Jersey side of the Lincoln Tunnel. Photo and data courtesy of Duro-Test Corp., North Bergen, N. J.

New Standards to Be Developed For Lighting and Ventilation

Work on standardization of building code requirements for lighting and ventilation, to replace the 1946 American Standard on the subject, is scheduled to begin shortly under a reorganized sectional committee of the American Standards Association. As a result of recommendations by representatives of IES, the American Society of Heating, Refrigerating and Air-Conditioning Engineers and the American Public Health Association, ASA is considering enlargement of the sectional committee, new administrative sponsors for the light and ventilation codes and a well-defined scope.

Tentative plans for work on the new standards call for the formation of IES and ASHRAE subcommittees to prepare drafts of minimum requirements for daylight and electrical light and natural and mechanical ventilation and air conditioning. A target date of February 1962 has been set for presentation of the preliminary drafts to the reorganized sectional committee.

Pending approval by the Construction Standards Board of ASA, the American Public Health Association will serve as administrative sponsor, IES and ASHRAE as co-sponsors of the code. In addition, 17 organizations and associations in the lighting and ventilation fields will be invited to participate on the sectional committee.

Collected Works of Langmuir Published in 12 Volumes

The collected works of Dr. Irving Langmuir, one of three honorary members of IES, have been published in a 12-volume edition by the Pergamon Press. Each of the volumes is devoted to one or more fields of science in which Dr. Langmuir worked, among them, low pressure phenomenon; heat transfer, incandescent lamps and tungsten; thermionic phenomenon and electric discharge.

The compilation of Dr. Langmuir's works, both published and previously unpublished, is supplemented by articles by eminent scientists analyzing his contributions to science. A biography of Dr. Langmuir is included as part of Volume 12 of the edition.

A brochure on the complete edition may be obtained from the Pergamon Press, 122 East 55th St., New York 22, N. Y. Price of the entire set is $150. Volumes 1-11 may be obtained for $15 each; Volume 12 for $9.

Dr. Langmuir, who was associated with the General Electric Research Laboratory from 1909 until his death in 1957, was the first American industrial scientist to be awarded the Nobel Prize.

"Electricity Powers Progress" Theme of National Electrical Week

The 1961 observance of National Electrical Week, February 11-17, will be planned around the theme, "Electricity Powers Progress," emphasizing the role played by electricity in the achievement of our present standard of living. The theme was announced by Harold A. Webster, chairman of the National Electrical Week committee and president of the National Electrical Contractors Association, following a recent meeting of the NEW committee.

As in past years the committee will distribute planning guides and materials to aid national and local participation in the event. In 1961, more than 300 communities in the United States and Canada took part in the observance. Greater participation is expected in 1962.

National Electrical Week, celebrated annually during the week of Thomas A. Edison's birthday, is sponsored by trade organizations of electrical manufacturers, distributors, leagues, contractors, utilities, service and repair groups and unions.

Executive members of the NEW committee, in addition to Chairman Webster, include: vice-chairman — T. O. McQuiston, vice-president, Metropolitan Edison Co.; secretary—A. W. Hooper, executive director, National Association of Electrical Distributors; treasurer — L. W. O'Brien, public-relations services, General Electric Co. All four officers held similar positions on the 1961 committee.

Chicago Lighting Institute Offers Four Lighting Courses

The Chicago Lighting Institute has announced a program of four lighting courses—fundamental and advanced lighting design, wiring design and the Academy of Lighting Arts—for the 1961 fall quarter. The advanced design course will be conducted in nine weekly sessions; the three other courses in 12 sessions each. Tuition for each course is $25.

Raymond E. Wozniak is instructor for the fundamentals course; R. W. Turek

(*Continued on page* 23A)

APPLETON®

Intenso®

finest floodlight in the industry!

Appleton-Engineered for Amazing Efficiency!

Here's high floodlight operating efficiency PLUS real floodlight lumen output! To utilize the remarkable new 1500-Watt Quartz-Iodine Lamp to the fullest possible extent, Appleton has designed and developed this sensational new fixture.

For a host of hard-to-light situations, the Appleton Intenso Quartzlite 1500 floodlight complements the new, more powerful filament type lamp with truly compact design. Light in weight, easy to install, easy to handle, this floodlight will do a more efficient job than a comparable conventional floodlight.

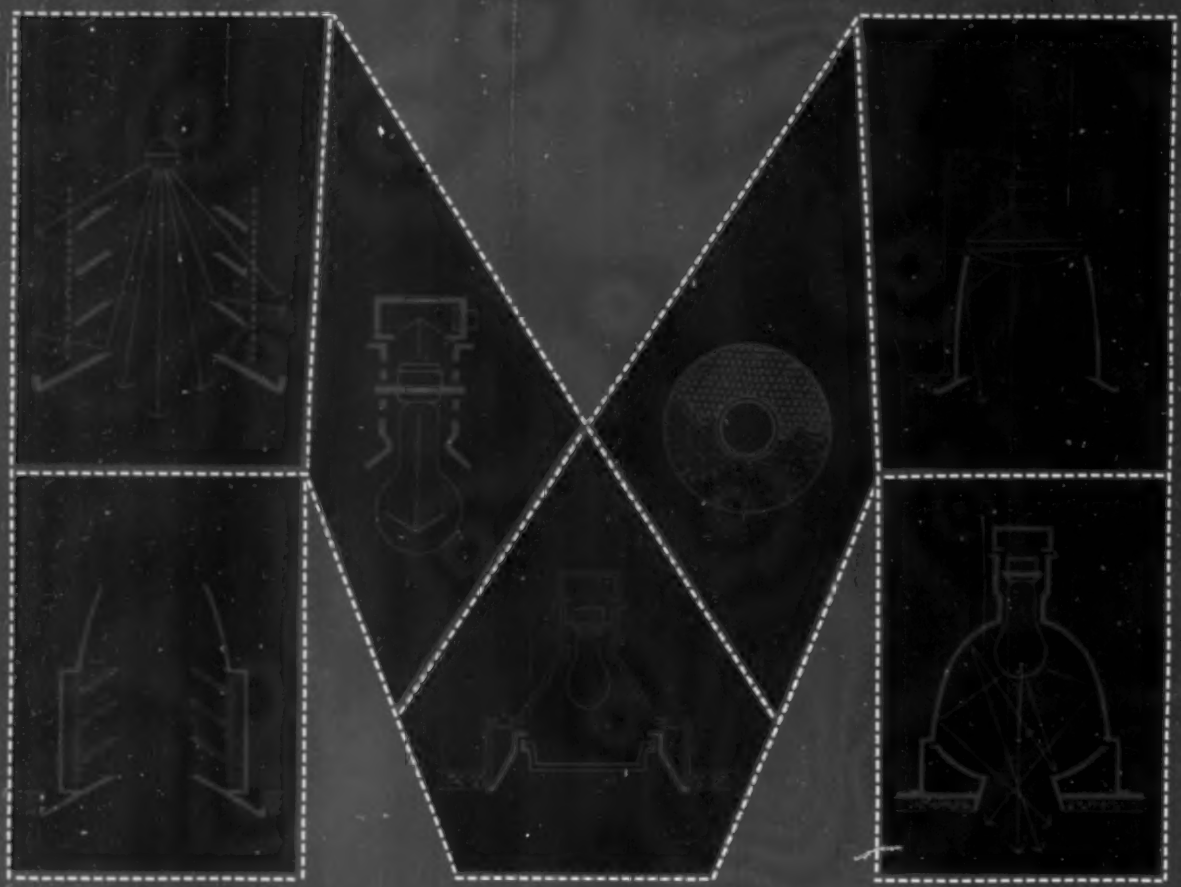
The 22 lumens per watt throughout life of the Quartzlite 1500-watt lamp represents 50% greater light than that of a 1500-watt PS52 lamp. It gives a full 22 lumens per watt constantly through a 2000 hour life.

The Quartzlite 1500 offers an unusually efficient beam pattern. Its beam spread in the vertical plane has a very sharp and easily controlled cutoff, eliminating excessive "spill" light. There is wide horizontal light distribution. This floodlight can be used either outdoors, or in most indoor areas.

Contact your Appleton Field Engineer, Franchised Distributor, or write today for Bulletin QL 13-161

APPLETON
electric company

1701 Wellington Avenue, Chicago 13, Illinois



innovations in lighting

Seven fundamentally new concepts in recessed incandescent lighting have been incorporated in our new collection of over 100 fixtures. Each solves a specific lighting problem. Use coupon below for handsome catalog.

MARCO

MARVIN ELECTRIC MANUFACTURING COMPANY
648 Santa Fe Avenue
Los Angeles 21, California

Please send me your new illustrated catalog on Innovations in Recessed Lighting.

Name_____

Firm_____

Street_____

City_____ Zone____ State____

(Continued from page 20A)

and Kerr Sanders will conduct the Academy of Lighting Arts; Melvin Cohen, advanced lighting design and Frank R. McShane, wiring design.

In addition to these regular courses, the Institute will offer periodic technical conferences for architects, building managers, engineers, contractors and interior designers, and nontechnical lectures on lighting for professional groups, trade associations and civic organizations.

Scholarship to Honor Maritime Member

At the Maritime Convention in Moncton, N. B., in June, plans were initiated to establish a scholarship in memory of the late Rolland W. Webb who died last fall. Mr. Webb was the first, and for many years, the only IES member in the Maritime area. Largely through his efforts as local representative in St. John, N. B., membership grew, meetings were organized and finally the Maritime Chapter (of which he was first Chairman) formed in April 1949. Three vigorous Chapters now in this area, Maritime, Bluenose and Northumberland, plan a scholarship for Mr. Webb's children, in grateful remembrance.

"Living Effects Laboratory" Now Under Construction

Construction of a full-scale "living effects laboratory" for testing and development work in residential electric lighting, heating, cooling and ventilating equipment, and joint research projects with builders, electrical contractors and architects has been announced by the Emerson Electric Manufacturing Co. It is expected that the building will provide an authentic home environment for testing by offering conditions difficult to achieve in research laboratories.

The structure, located at the company's headquarters in St. Louis, Mo., is scheduled for completion during the autumn of 1961.

Dorothy Nickerson Receives Third ISCC Godlove Award

The third Godlove Award of the Inter-Society Color Council has been presented to Dorothy Nickerson, United States Department of Agriculture, for "her valuable psychophysical studies of color spacing, color tolerances and color rendition, her development of instruments and methods of color measurements and inspection, [and] her applications of the

(Continued on page 24A)

SCHEDULED EVENTS

Dates of Interest to IES Members

1961

September

September 24-29—Illuminating Engineering Society, National Technical Conference, Chase-Park Plaza Hotel, St. Louis, Mo.

September 25-28—Industrial Building Exposition & Congress, New York Coliseum, New York, N. Y.

October

October 1-5 — Electrochemical Society, 120th Annual Meeting, Statler-Hilton Hotel, Detroit, Mich.

October 2-6 — Society of Motion Picture and Television Engineers, Semi-Annual Convention, Lake Placid Club, Lake Placid, N. Y.

October 3-5—Lighting Progress Exposition, sponsored by Electrical League of Southern California, Hollywood Palladium, Hollywood, Calif.

October 3-5—Delaware Valley Electrical Progress Show, Convention Hall, Philadelphia, Pa.

October 4-6—Canadian Electrical Manufacturers Association, Annual Meeting, Sheraton-Brock Hotel, Niagara Falls, Ont.

October 4-6—International Association of Electrical Leagues, Annual Conference, President Hotel, Atlantic City, N. J.

October 8-10 — United States National Committee, CIE, Annual Meeting, Olentangy Inn, Columbus, Ohio.

October 9-11—Annual National Electronics Conference, International Amphitheatre, Chicago, Ill.

October 10-12—American Standards Association, National Conference on Standards, Rice Hotel, Houston, Texas.

October 10-13—National Electrical Contractors Association, Annual Convention and Exposition, Washington, D. C.

October 15-20—American Institute of Electrical Engineers, Fall General Meeting, Detroit, Mich.

October 18-20—Optical Society of America, Annual Meeting, Biltmore Hotel, Los Angeles, Calif.

November

November 6-8—National Warm Air Heating and Air Conditioning Association, Annual Convention, LaSalle Hotel, Chicago, Ill.

November 9-10 — IES Council Meeting, United Engineering Center, 345 East 47th St., New York, N. Y. Members are invited to attend meetings of Council as guests.

November 16—National Electrical Manufacturers Association, Annual Meeting, Plaza Hotel, New York, N. Y.

November 24-29 — 1961 Electrical and Home Appliance Show, Electric Building, Balboa Park, San Diego, Calif.

1962

January

January 22-25 — National Plant Maintenance & Engineering Show, Convention Hall, Philadelphia, Pa.

January 25-27—National Society of Professional Engineers, King Edward Hotel, Jackson, Miss.

January 29-February 2 — Electrical Engineering Exposition, sponsored by the American Institute of Electrical Engineers, New York Coliseum, New York, N. Y.

January 30-February 2 — Society of the Plastics Engineers, Annual Technical Conference, Penn-Sheraton Hotel, Pittsburgh, Pa.

February

February 5-9—American Society for Testing Materials, Statler-Hilton Hotel, Dallas, Texas.

February 6-8—Society of the Plastics Industry, Reinforced Plastics Division Conference, Edgewater Beach Hotel, Chicago, Ill.

February 8-9 — IES Council Meeting, United Engineering Center, 345 East 47th St., New York, N. Y. Members are invited to attend meetings of Council as guests.

1961-62 National and Local Officers

A complete listing, including business addresses, of all IES national officers and Section/Chapter chairmen and secretaries, will be published in October IE. Use this list as a handy directory of these active IES members.

(*Continued from page 23A*)

Munsell color system in devising systems of color standards for special purposes.''

Miss Nickerson, a Fellow of IES, has had a career of 40 years in color; five years on the staff of the Munsell Color Co. and Research Laboratory and the remainder with the Cotton Division of the Department of Agriculture. Her contributions to the science of color, noted in the Award citation, have been documented in over 100 technical papers published since 1928.

The Godlove Award, established in 1956, is presented bienially for outstanding contributions to color. Previous recipients have been Dr. Deane B. Judd, this year's IES Gold Medalist, and Ralph M. Evans.

ABOUT PEOPLE

Parenthetical designations denote membership grade in the Society.

Ralph J. Cordiner, chairman of the board and chief executive officer of the General Electric Co., has announced the elections, by the board of directors, of **Gerald L. Phillippe** as president and **Cramer W. LaPierre** as executive vice-president of the company. Concurrently, both men were elected directors. Mr. Phillippe had served as comptroller and chief financial officer of the company since 1953; Mr. LaPierre had previously been vice-president and group executive in charge of the Electronic and Flight Systems Group. In making the announcement of these elections, Mr. Cordiner stated that all operating components of the company would continue to report to him through five group executives.

W. P. White, Jr., has been appointed executive vice-president of Appleton Electric Co., Chicago, Ill., according to a recent announcement. Mr. White had previously been associated with Continental Can Co. and the White Cap Co.

The election of **Frederick Cox** as vice-president of Metropolitan Edison Co., Reading, Pa., was recently announced by company president W. R. Snyder. For the past five years Mr. Cox had served as manager of the company's Western (York, Pa.) Division.

Harry L. Niederauer is the newly appointed manager of marketing services for Westinghouse Lamp Division, Bloomfield, N. J. Mr. Niederauer, who was most recently a vice-president of Fuller & Smith & Ross, Inc., advertising agency, had been associated with the Westinghouse Lamp Division as advertising and sales promotion manager from 1943 to 1954. In his new position, he will report to **Charles E. Erb,** the division marketing manager.

Electrical Agencies, Inc., Boston, Mass., headed by **Jack Leary,** has been named New England sales representative for fluorescent and mercury ballasts by the Sola Electric Co., Elk Grove, Ill. **Richard Hesse** (A), Newton, Mass., will continue to represent the company's line of constant voltage transformers and power supplies in New England.

Luxo Lamp Corp., Port Chester, N Y., has established an office in Chicago under the supervision of **John S. Sprenger.** He will serve as the company's full-time factory representative in the states of Illinois, Wisconsin and Indiana.

C. W. McDaniel, recently appointed general manager of the Electrical Products Division, Fostoria Corp., Fostoria, Ohio, has named **C. A. Williams** as manager of engineering and **R. E. Justice** as manager of manufacturing. Assisting Mr. Williams will be **E. N. Schalk,** manager, application engineering; **Hugh Williams,** manager, drafting; and **Rex Boyd,** manager of product testing and quality control. **R. L. Hill,** purchasing manager; **Alex Such,** manufacturing manager; and **J. C. Case,** general foreman; will report to Mr. Justice. The Electrical Products Division manufactures critical work area lighting equipment, infrared comfort conditioning equipment and infrared process equipment.

It Seems To Me . . .

A Note on Converter Equipment

This letter is intended as an addenda to the article, ''Converter Equipment,'' by Shelley Krasnow, published in July 1957 ILLUMINATING ENGINEERING, pp. 353-356. In that article there was described a rotating type frequency converter, especially designed for high frequency lighting service. The unit operated from a 60-cycle source and delivered 600 volts at 840 cycles.

A statement was made in the article to the effect that the converter was immune to prolonged short circuits. While this statement was true for earlier models of this converter, it is now no longer true and we wish to apprise users of this.

The loss of what appears to be a very desirable property is, paradoxically, due to improvements in other characteristics of the machine. Among these improvements are a greater KVA output from a given size machine frame and superior insulation, to protect against high-voltage breakdown within the windings.

As in all engineering matters, compromise is involved. It was felt that protection against high-voltage breakdown was a more desirable characteristic than immunity to greatly prolonged short circuits. The latter can be avoided by conventional protective devices (such as fuses).

Machines made since the publication of the article will stand a short circuit for a sufficient time for the most sluggish protective device to act. They will stand a rather prolonged short circuit on all three phases of a machine, though this is a rather uncommon happening in practice. For the more usual types of short circuits across one phase, or a portion of one phase only, a machine, after running hot and fully loaded, will stand the short for at least several seconds. This is sufficient even for a very slow protective circuit breaker or fuse to operate. No loss of the permanent magnetism of the magnets in the rotor will result from this.—SHELLEY KRASNOW, Georator Corp., Manassas, Va.

NEW MEMBERS

At the August 4, 1961, meeting of the Council Executive Committee in Wheeling, W. Va., the following were elected to membership. Names marked * are transfers from Associate Member grade.

CANADIAN REGION

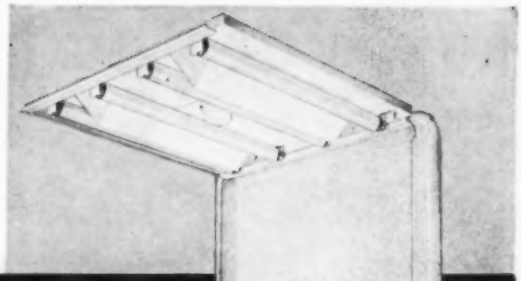
BLUENOSE CHAPTER

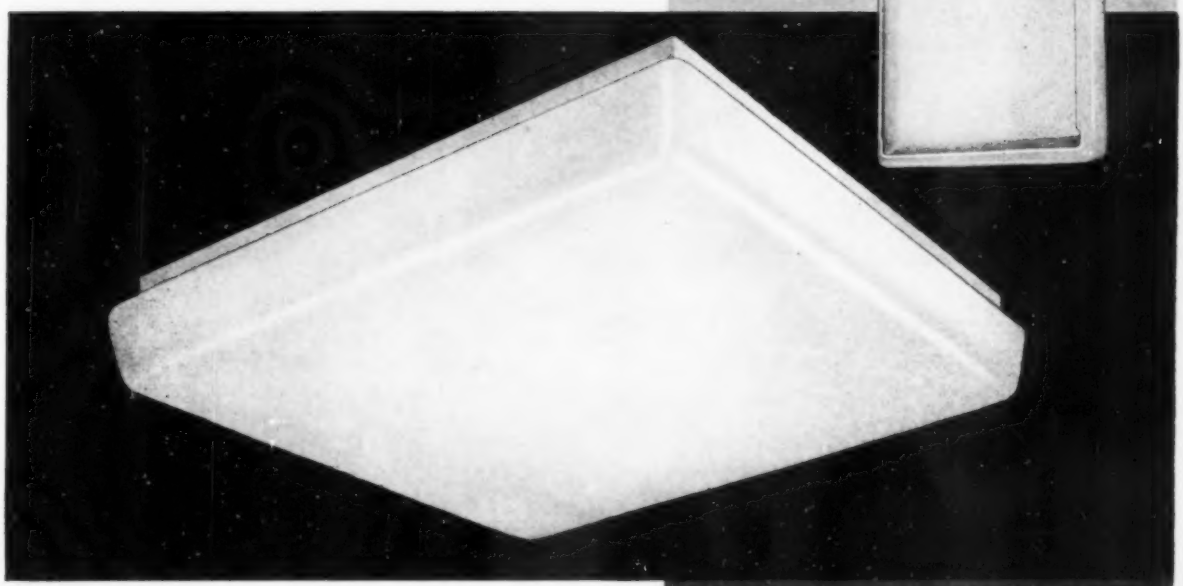
Member:

*Ferraris, J. G., J. A. Wilson Lighting Ltd., Armdale Post Office, N. S.

(*Continued on page 26A*)

NEW TWO-BY-TWO SURFACE-MOUNTING LIGHTING FIXTURE





GAR-LITE 909

The latest in lighting for lobbies, corridors, small offices, shops, etc., is new in size, new in style, and new in several important features:

NEW SIZE. The 28" x 28" size is perfect for many areas where large square fixtures or long ones would be out of place. Takes 4 - 20 W, 24" lamps . . . not odd-size or circline lamps as in similar fixtures.

NEW AND UNIQUE DIFFUSER. The shallow (4"), crisply styled diffuser "wraps around" on all four sides. It conceals the chassis in the normal view.

EASY HINGING. The diffuser hinges from either side without latches. Cleaning and re-lamping are quick and easy.

The 909 is fully described in bulletin 61-09. Write, wire or phone for your copy.

DISTRIBUTED EXCLUSIVELY BY GAR-LITE DISTRIBUTORS

GARCY LIGHTING

Div. of Garden City Plating & Mfg. Co.
2475 Elston Avenue • Chicago 47, Ill.

Installations in the News...

Residential Atmosphere Keynotes Medical Center Design

Combination of dramatic architectural effects and a warm lighting atmosphere prevents an "institutional look" at the new Royal Oak Medical Center, located in a northern Detroit suburb. The building, designed by Leonard G. Siegel, features a multi-level central area built of exposed steel frame supporting component plywood arches. Exposed concrete panels alternated with sections of glass, covered by gold anodized aluminum grilles, form the facade. Spotlighting on the concrete panels accents the architectural design at night.

Specially-designed six-inch cylinders, which provide both up- and downlight, are used to light the lobby. Suspended by aluminum tubing supported by adjacent steel beams, these units create the effect of a floating ceiling beneath the vaulted roof. In the examination suites (not shown) warm white deluxe fluorescent lamps in low brightness luminaires are used in conjunction with incandescent downlights and wall brackets.

Photo and data are courtesy of K & S Electric Co., Inc., Detroit, Mich.

(*Continued from page* 24A)

FOREST CITY (LONDON) CHAPTER

Associate Member:
Forman, J. R., Dow Chemical of Canada, Ltd., Sarnia, Ont.

GOLDEN WEST CHAPTER

No Elections

HAMILTON, ONTARIO CHAPTER

No Elections

MARITIME CHAPTER

Associate Member:
Evans, J. H., New Brunswick Telephone Co., Ltd., Saint John, N. B.

MONTREAL SECTION

Member:
Smith, R. H., Jas. P. Keith & Associates, Montreal, Que.
Associate Member:
Perry, G. H., 187 Dufferin St., Granby, Que.

NORTHUMBERLAND CHAPTER

Associate Member:
Melanson, L. Y., Acme Electric Ltd., Moncton, N. B.

OTTAWA SECTION

Associate Members:
Pezoulas, N., Royal Canadian Air Force Headquarters, Ottawa, Ont.
Williams, S. P., Department of Transport, Government of Canada, Ottawa, Ont.

QUEBEC CHAPTER

No Elections

ST. MAURICE VALLEY CHAPTER

No Elections

TORONTO SECTION

Member:
Wagman, M., Revere Electrical Distributors, Ltd., Toronto, Ont.
Associate Members:
Greenbaum, L., Superior Electric Supply Co. of Toronto, Ltd., Toronto, Ont.
Hart, A. D., Powco Steel Products Ltd., Toronto Ont.
Lenson, W. J., W. J. Lenson & Associates, Ltd., Sault Ste. Marie, Ont.

WINNIPEG CHAPTER

Member:
*Buckler, V. S., Green, Blankstein, Russell & Associates, Winnipeg, Man.
Associate Members:
Baxter, F. D., Bancroft, Bodel & Inch Western Ltd., Winnipeg, Man.
McLeod, D. H., Ward & MacDonald Associates, Brandon, Man.

EAST CENTRAL REGION

BLUE RIDGE CHAPTER

Associate Members:
Avery, F. J., Jefferson Electric Co., Inc., Roanoke, Va.
Dobbins, M. E., Graybar Electric Co., Roanoke, Va.
French, J. W., Appalachian Power Co., Roanoke, Va.
Gilbert, L. T., Williams Supply, Inc., Roanoke, Va.
Graham, A. L., Jr., Appalachian Power Co., Pulaski, Va.
Higgins J. D., Appalachian Power Co., Fieldale, Va.
Reynolds, C. L., Appalachian Power Co., Roanoke, Va.
Smythers, H. M., Appalachian Power Co., Roanoke, Va.
Williams, F. S., Williams Supply, Inc., Roanoke, Va.

CAPITAL SECTION

Associate Member:
Travesky, P. D., National Bureau of Standards, Washington, D. C.

EASTERN PENNSYLVANIA SECTION

Member:
*Rehman, J. P., Dauphin Electrical Supplies Co., Harrisburg, Pa.
Associate Member:
Deppen, R. W., Pennsylvania Power and Light Co., Sunbury, Pa.

MARYLAND SECTION

Associate Members:
Lemel, I., Department of Education of Baltimore, Baltimore, Md.
Smith, E. F., U. S. Army, Fort Holabird, Baltimore, Md.

PHILADELPHIA SECTION

Member:
Watmough, A. L., Louis J. Lerro Co., Inc., Philadelphia, Pa.

(*Continued on page* 58A)

Niagara-Mohawk Power Corporation, Huntley Station, Buffalo, New York.

Power company selects Abolite...

Gets easy-on-the-eyes lighting, and holds the line on costs

INSTALLATION DATA

Abolite HMFAU-2400 Alzak aluminum uplight fixtures with 1000 watt color-improved mercury lamps. Ceiling height 65', mounting height 55', spacing 18' x 24'. Average maintained footcandle level: 30.

Electrical Contractor: Buffalo Electric Co.

Engineers at this power plant wanted high bay lighting that combined comfort with low installation and maintenance costs. They got it by installing Abolite fixtures equipped with 1000 watt color-improved mercury lamps.

Though these fixtures are mounted 55 feet high, they provide comfortable, glareless 30 footcandle average light throughout the building. Light directed upward through the fixtures' open tops washes out dark ceiling shadows. 35° shielding of lamp virtually eliminates glare.

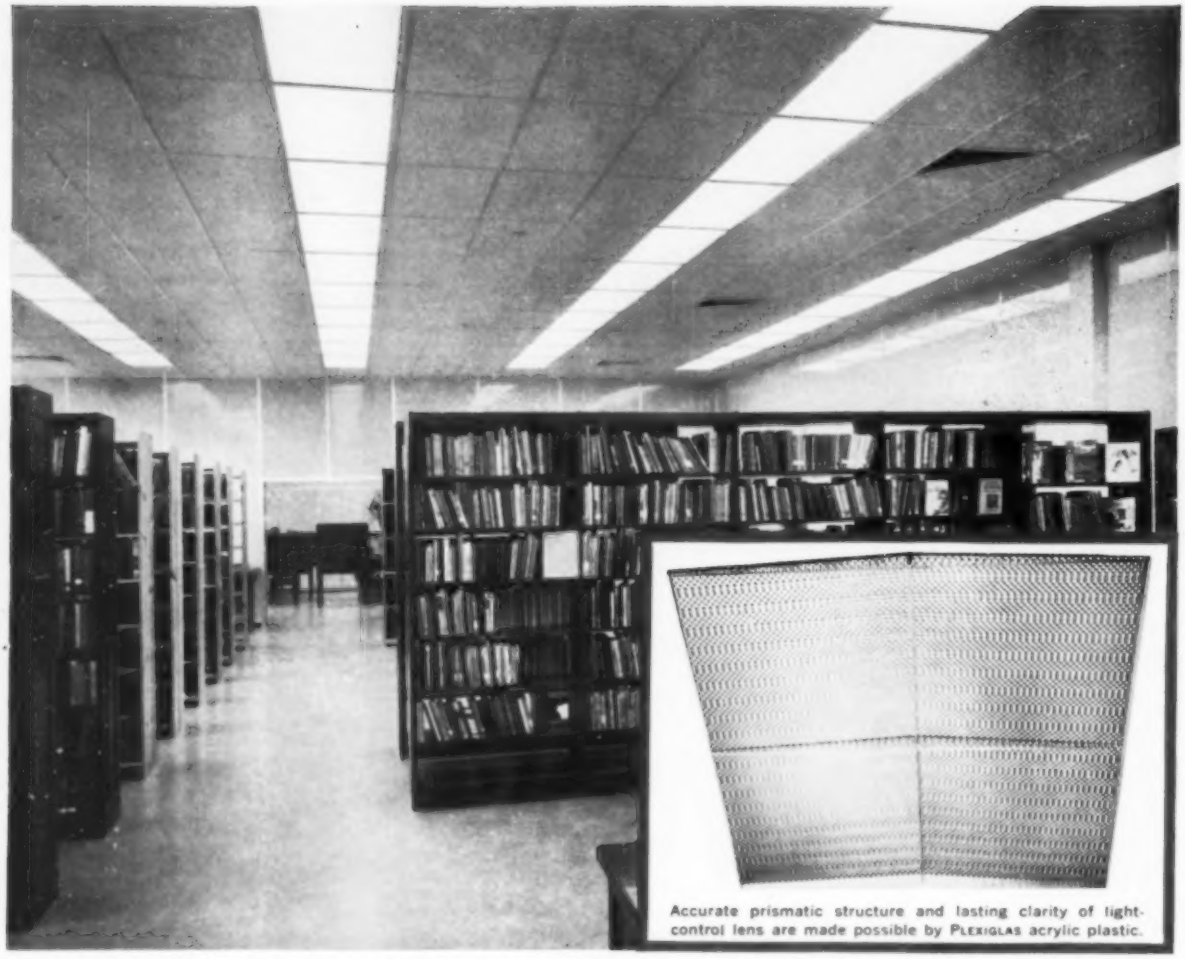
Most important, this system costs less to buy and maintain than a comparable fluorescent system because fewer fixtures are needed. Maintenance costs are less, too, because air circulating through Abolite's open-top fixtures sweeps them clean of dulling dust.

For high bay lighting that combines both comfort *and* economy, specify Abolite fixtures. The complete line includes RLM-approved Alzak aluminum and porcelain enamel fixtures for use with all kinds of mercury and incandescent lamps. Write for more information.

ABOLITE *Lighting*

THE JONES METAL PRODUCTS COMPANY

West Lafayette, Ohio



Accurate prismatic structure and lasting clarity of light-control lens are made possible by PLEXIGLAS acrylic plastic.

Control lenses molded of PLEXIGLAS mounted in continuous rows in library of County of Sonoma school administration building, Santa Rosa, California. Architects: Steel & Van Dyke, Santa Rosa.

Plexiglas...for lighting that stands out and stands up

When lighting equipment includes control lenses molded of PLEXIGLAS® acrylic plastic, the result is illumination of the highest quality. This is because PLEXIGLAS makes possible a precisely designed optical element that directs light to the area where it is required and, at the same time, minimizes the surface brightness of the lens as seen from normal viewing angles.

In addition, lenses of PLEXIGLAS remain free of discoloration even after years of exposure to fluorescent light. They are strong and rigid yet light in weight, resulting in safety overhead and ease of maintenance. And the crystal clarity of PLEXIGLAS assures full utilization of light.

Full details on the use of PLEXIGLAS as a lighting material are contained in our 40-page technical bulletin "PLEXIGLAS for Lighting". We will be glad to send you a copy.

ROHM & HAAS

PHILADELPHIA 5, PA.

In Canada: *Rohm & Haas Co. of Canada, Ltd., West Hill, Ontario*

PLEXIGLAS

SUSTAINING MEMBERS

A

Abbey Electric Co.
15 E. 69th St.
Chicago 37, Ill. *Ted Cohan*

Abolite Lighting Division
Jones Metal Products Co.
West Lafayette, Ohio *E. F. Mulligan*

Acme Lighting & Mfg. Co.
949-65 E. 31st St.
Los Angeles 11, Calif. *Albert Sultan*

Active Electric Co.
5450 W. Fullerton Ave
Chicago 39, Ill. *Robert W. Winne*

Advance Lighting Ltd.
106 Midland St.
Winnipeg, Man. *J. M. Kerluke*

Advance Transformer Co.
2950 N. Western Ave.
Chicago 18, Ill. *A. E. Feinberg*

Ainsworth Electric Co. Ltd.
131 Bermondsey Road
Toronto 16, Ont. *K. D. Ainsworth*

Alabama Power Co.
600 N. 18 St.
Birmingham 2, Ala. *G. L. Morris*

Alkco Manufacturing Co.
4224 N. Lincoln Ave.
Chicago 18, Ill. *A. J. Kurtzon*

Allan Electric Co.
42 Park Ave.
Paterson, N. J. *L. R. Shapiro*

Allied Chemical Corp.
Plastics and Coal Chemical Division
40 Rector St.
New York 6, N. Y. *Dr. M. H. Bigelow*

Edward P. Allison Co., Inc.
300 W. Washington St.
Chicago 6, Ill. *C. W. Abrell*

Aluminum Co. of America
Alcoa Process Development Laboratories
P. O. Box 1012
New Kensington, Pa. *R. V. Vandenberg*

Amalgamated Electric Corp. Ltd.
384 Pape Ave., Toronto, Ont. *George T. Watson*

American Concrete Corp.
5092 N. Kimberly Ave.
Chicago 30, Ill. *J. W. Lewis*

American Electric Construction Co., Inc.
4453 N. Central Ave.
Chicago 30, Ill. *Clyde W. Grove*

American Louver Co.
5308 N. Elston Ave.
Chicago 30, Ill. *G. M. Glass*

American-Saint Gobain Corp.
2000 Farmers Bank Bldg.
Pittsburgh 22, Pa. *F. W. Mowrey*

American Sterilizer Co.
2426 W. 23rd St., Erie, Pa. *Howard Haynes*

Charles A. Anderson & Co.
1214 Nicollet Ave.
Minneapolis 4, Minn. *George R. Anderson*

Warren D. Anderson Sales Co.
P.O. Box 8023, Miracle Mile Branch
Minneapolis 16, Minn. *W. D. Anderson*

Appalachian Power Co.
40 Franklin Rd., S. W., P. O. Box 2091
Roanoke, Va. *R. E. Hodges*

Appleton Electric Co.
1701-1759 Wellington Ave.
Chicago 13, Ill. *Norton Appleton*

Arco Electric Supply Co., Inc.
201 E. 42nd St.
New York 17, N. Y. *P. D. Samberg*

Arizona Public Service Co.
501 S. Third Ave.
Phoenix, Ariz. *Don Willis*

Arkansas Power & Light Co.
Little Rock, Ark. *E. G. Barry*

The Art Metal Co.
1814 E. 40th St.
Cleveland 3, Ohio *G. E. Glatthar*

Atlantic City Electric Co.
1600 Pacific Ave.
Atlantic City, N. J. *I. C. Dixon*

B

Baltimore Gas & Electric Co.
1212 Lexington Bldg.
Baltimore 1, Md. *M. C. Albrittain*

Beaux Arts Lighting Co. Inc.
111 E. 12th St., New York, N. Y. *Irwin Kamin*

Benjamin Division
Thomas Industries Inc.
Des Plaines, Ill. *B. S. Benson, Jr.*

Black & McDonald Ltd.
101 Parliament St.
Toronto, Ont. *W. J. McDonald*

The Blommel Sign Co.
735 Wayne Ave.
Dayton 10, Ohio *W. E. Blommel*

BMD and R, Inc.
7020 Walker St., St. Louis Park
Minneapolis, Minn. *Cecil H. Branham*

Board of Water and Light
116 W. Ottawa St., P. O. Box 570
Lansing 3, Mich. *Roy Culham*

Boston Edison Co.
182 Tremont St.
Boston 12, Mass *Dale E. Washburn*

British Columbia Electric Co. Ltd.
970 Burrard St.
Vancouver 1, B. C. *R. G. Scott*

British Columbia Electric Co. Ltd.
820 Pandora Ave.
Victoria, B. C. *W. C. Mearns*

Broadway Maintenance Corp.
1271 McCarter Highway
Newark 4, N. J. *Charles Fogarty*

Brockton Edison Co.
36 Main St.
Brockton 67, Mass. *C. F. Werner*

Buck Electrical Contractors Inc.
5246 W. Fullerton Ave.
Chicago 39, Ill. *Anton J. Mayer*

Buffalo Electric Co., Inc.
75 W. Mohawk St.
Buffalo 2, N. Y. *Clair O. Dean*

Butler Electric Co. Inc.
2832 Washington Ave.
St. Louis, Mo. *Henry Arendes*

C

C. & M. Products Ltd.
124 Crockford Blvd.
Scarboro, Ont. *J. J. Caragata*

C & S Lighting Maintenance Co.
11015 Briggs Road
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Cadillac Electric Supply Co.
431 E. Larned St.
Detroit 26, Mich. *H. C. Simonton*

California Electric Power Co.
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San Bernardino, Calif. *W. F. Lambirth*

Camber Lighting Inc.
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Jersey City, N. J. *Leonard Borko*

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Canadian General Electric Co. Ltd.
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224 Wallace Ave., Toronto, Ont. *A. C. Calderone*

Canadian General Electric Co. Ltd.
Lamp Division
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Canadian National Exhibition Association
Exhibition Park
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Canadian Utilities, Ltd.
Milner Bldg.
Edmonton, Alta. *J. E. Bagshaw*

Canadian Westinghouse Co. Ltd.
Lighting Division
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2144 N. Wood St.
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Capitol Stage Lighting Co., Inc.
527 W. 45th St.
New York 36, N. Y. *J. B. Phillips*

Central Electric Supply Co.
P. O. Box 267
Denver, Colo. *Edward S. Goldman*

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Central Hudson Gas & Electric Corp.
50 Market St.
Poughkeepsie, N. Y. *J. E. Doolittle*

Central Illinois Light Co.
300 Liberty St.
Peoria 2, Ill. *J. W. Brown*

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607 E. Adams St.
Springfield, Ill. *B. L. Palm*

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715 Main St.
Pineville, La. *P. R. Taylor*

Central Maine Power Co.
9 Green St.
Augusta, Me. *Roland W. Hess*

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Century Lighting, Inc.
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Chicago Miniature Lamp Works, Inc.
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Cincinnati 1, Ohio *J. R. Hartman*

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P. O. Box 631
Burbank, Calif. *Ralph Foy*

City of Glendale — Public Service Dept.
119 N. Glendale Ave.
Glendale 6, Calif. *L. W. Grayson*

City of Los Angeles, Dept. of Water & Power
207 So. Broadway
Los Angeles 54, Calif. *Ivan L. Bateman*

City of Pasadena
Municipal Light & Power Dept.
302 City Hall, Pasadena 1, Calif. *T. M. Goodrich*

City of Riverside — Electric Light Dept.
P. O. Box 826
Riverside, Calif. *Everett C. Ross*

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1015 Third Ave.
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P. O. Box 1639
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The Cleveland Electric Illuminating Co.
P.O. Box 5000
Cleveland 1, Ohio *R. C. Hienton*

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Columbia Lighting
2510 N. Fancher Way
Spokane, Wash. *Walter A. Toly*

Columbus & Southern Ohio Electric Co.
215 N. Front St.
Columbus, Ohio *H. S. Corn*

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215 S. Morgan St.
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Chicago 90, Ill. *O. A. Hill, Jr.*

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P. O. Box 2010
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Jackson, Mich. *B. G. Campbell*

Consumers Public Power District
1452 25th Ave.
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Crownlite Fluorescent Co.
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Curtis-AllBrite Lighting, Ltd.
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Leaside, Toronto, Ont. *H. L. Wright*

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Philadelphia 39, Pa. *David Cutler*

D

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1506 Commerce St.
Dallas 1, Texas *C. A. Tatum*

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Day-Brite Lighting Inc.
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St. Louis 66, Mo. *C. L. Amick*

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25 No. Main St.
Dayton 1, Ohio *H. S. Nonneman*

Dazor Manufacturing Corp.
4483 Duncan Ave.
St. Louis 10, Mo. *P. L. Read*

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Bedford Park, Argo P.O., Ill. *E. J. Porter*

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Duquesne Light Co.
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North Bergen, N. J. *James L. Cox*

E

Ebasco Services, Inc.
2 Rector St., New York 6, N. Y. *W. L. Byrne*

William LeRoy Edwards—
Consulting Engineer
165 Alexander St., N.W.
Atlanta, Ga. *W. L. Edwards*

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Electric Supply Co.
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Atlanta, Ga. *W. W. Crowe*

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2132 Fordem Ave.
Madison 1, Wis. *D. W. Grosshandler*

Electrical Testing Laboratories, Inc.
2 East End Ave.
New York 21, N. Y. *Hoffman S. Beagle*

Electrical Wholesalers, Inc.
229 Whitehall St. S. W.
Atlanta, Ga. *F. H. Dendy, Jr.*

Electrolier Mfg. Co. Ltd.
5849 Boyer St.
Montreal, Que. *Bernard Issenman*

Electro Lighting Corp.
1535 S. Paulina St.
Chicago 8, Ill. *C. I. Schneider*

Emerson-Pryne Co.
P.O. Box 698
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Ender-Monarch Corp.
141 Lanza Ave.
Garfield, N. J. *Lewis Grenadier*

Englewood Electrical Supply Co.
5801 S. Halsted St.
Chicago, Ill. *John E. Smith*

F

Fecht Electric, Inc.
5736 N. Western Ave.
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Federal Pacific Manufacturing Co.
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Fischbach, Moore & Morrissey, Inc.
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Chicago 2, Ill. *J. R. Meehan*

Fitchburg Gas & Electric Light Co.
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Flood-Lite Service Inc.
212 Silver Lake Blvd.
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Florida Power Corp.
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Florida Power & Light Co.
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W. Freeman & Son, Ltd.
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The Frink Corp.
211 63rd St.
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G

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St. Louis 3, Mo. — *Dan Michelson*

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Outdoor Lighting Dept.
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Div. General Electric Co.
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New Haven, Conn. — *Malcolm Rosen*

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Niagara Falls, Ont. — *J. A. Williamson*

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Toronto 2, Ont. — *G. E. Davidson*

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Chicago, Ill. — *Jay Mann*

I

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Iowa Electric Light & Power Co.
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Iowa Power & Light Co.
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400 Commercial St.
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Iowa Public Service Co., Sioux City Division
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J

Jefferson Electric Co.
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Jersey Central Power & Light Co.
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Chicago, Ill. — *Chas. Meyerson*

Jewell Electric Products Inc.
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Fairlawn, N. J. — *R. J. Parks*

Joslyn Mfg. & Supply Co.
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Chicago 9, Ill. — *J. H. Fahey*

K

Kansas City Power & Light Co.
P. O. Box 679
Kansas City 41, Mo. — *W. K. Frohock*

Kansas Gas & Electric Co.
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Chicago 6, Ill. — *Sigmund A. Hollinger*

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Waterbury, Conn. *Richard L. Platt*

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St. John, N. B. *H. D. MacMackin*

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New York 17, N. Y. *M. R. Minto*

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Chicago, Ill. *Ross O. Major*

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Massachusetts Electric Co.
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Quincy 69, Mass. *Richard L. Noble*

Massachusetts Electric Co.
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McNaughton-McKay Electric Co.
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Detroit 58, Mich. *William T. McNaughton*

McPhilben Manufacturing Co., Inc.
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Brooklyn 37, N. Y. *Edward L. Gluck*

McWilliams Electric Co. Inc.
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Chicago 47, Ill. *George P. Schannon*

Meade Electric Co. Inc.
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Chicago 44, Ill. *Henry E. Burkhardt*

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West Haven, Conn. *S. R. Shemitz*

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Philadelphia, 35, Pa. *Fred M. Pyle*

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Detroit 21, Mich. *Milton J. Doner*

Midwest Chandelier Co.
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No. Kansas City 16, Mo. *Sidney Lefkovitz*

Midwest Electric Co.
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Minneapolis 15, Minn. *Don Carlson*

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Meriden, Conn. *John J. Neidhart*

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Inwood 96, L. I., N. Y. *Milton Liberman*

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Mississippi Power Co.
Gulfport, Miss. *V. J. Daniel, Jr.*

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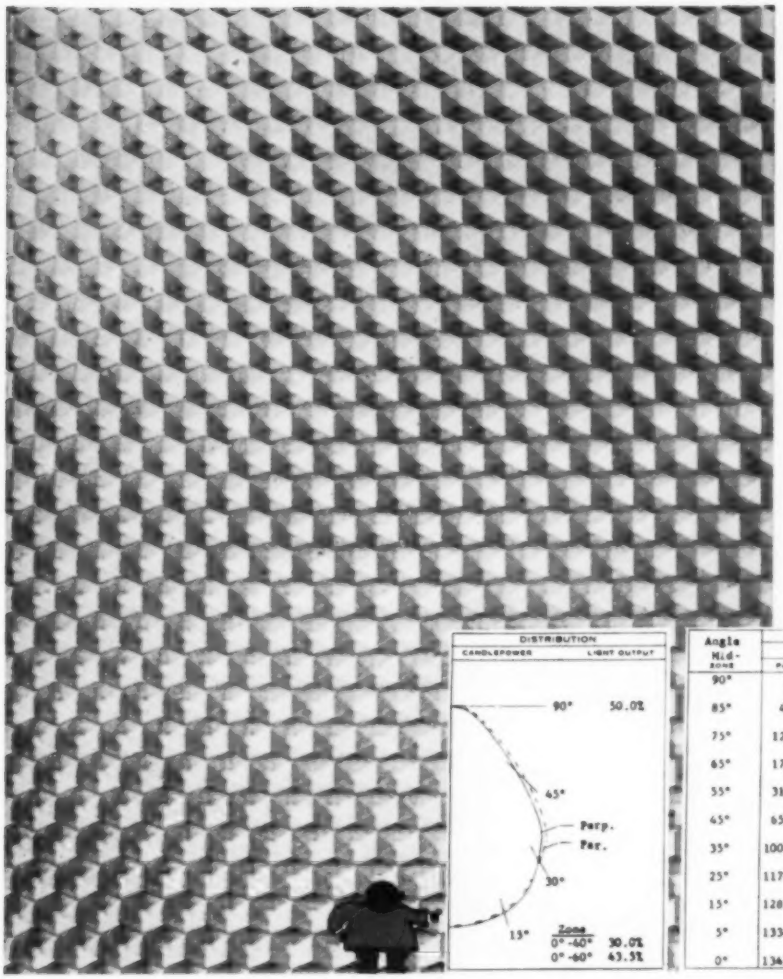
233 Fifth Avenue
New York 16, N. Y. *Morris Thau*

(Continued on page 36A)

announcing the New EXTRU-LITE® Pattern R-7

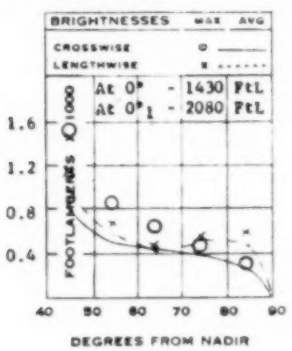


our famous plastic low brightness lensware — NOW extruded in a Brand NEW PATTERN.

Pattern R-7, with optically engineered hexagonal pyramids, permits the light to enter at all angles from the light source. It diffuses and refracts the light onto the work surface with a low brightness that is highly desirable for all types of visual tasks.

This 6-sided prismatic pattern controls, directs and reflects the rays to provide a glareless, more uniform light distribution.

Angle Mid-Zone	MID-ZONE CANDLEPOWER HORIZONTAL ANGLES PAR	22½	45	67½	PERP	LUMENS
90°	0		0		0	-
85°	40.2		40.2		25.3	40
75°	127		125		96.9	125
65°	176		200		179	188
55°	317		313		279	274
45°	653		620		554	472
35°	1003		1000		970	625
25°	1177		1198		1196	551
15°	1281		1293		1301	365
5°	1334		1335		1338	127
0°	1341		1341		1361	-



IMPORTANT! Superior Advantage of Pattern R-7 over other hexagonal shapes: The secret of positive light control is in the *raised prisms*—it's *outstanding* in more ways than one.

Available immediately from stock up to 24" wide in Polystyrene or Acrylic.

Write or call our Dept. BK at our factory or our Sales Offices listed below today for Sample of Extru-Lite R-7. It's tougher, safer, and lighter than other materials.

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WEllington 3-2171

(Continued from page 34A)

N

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Providence 1, R. I. — *F. E. Caulfield*

National Electric Wholesalers, Inc.
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O

Ohio Edison Co.
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P

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Q

Quadrangle Mfg. Co.
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(Continued on page 38A)

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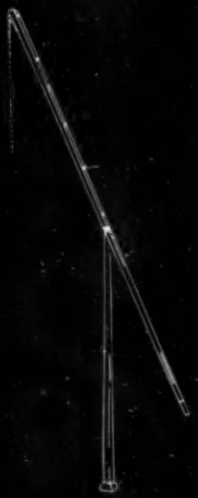
RIGID POLES



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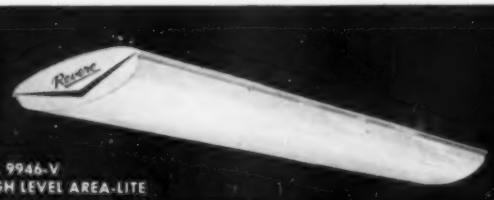
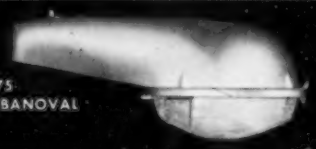


No. 9946-V
HIGH LEVEL AREA-LITE

No. 2633-B400
UNITIZED ENDOVAL



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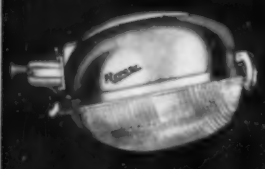
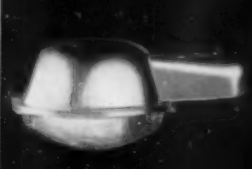
UNITIZED URBANOVAL



No. 2274
ENDOVAL



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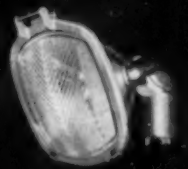
URBANOVAL



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QUARTZOVAL "500"

(Continued from page 36A)

Quebec Hydro-Electric Commission
107 Craig St. W.
Montreal, Que. *R. E. Gohier*

Quebec Power Co.
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Quebec, Que. *Jean Saint-Jacques*

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The Superior Electric Co.
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345 Richmond St., London, Ont. *E. J. Lewicki*

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6255 Cote de Liesse Road
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T

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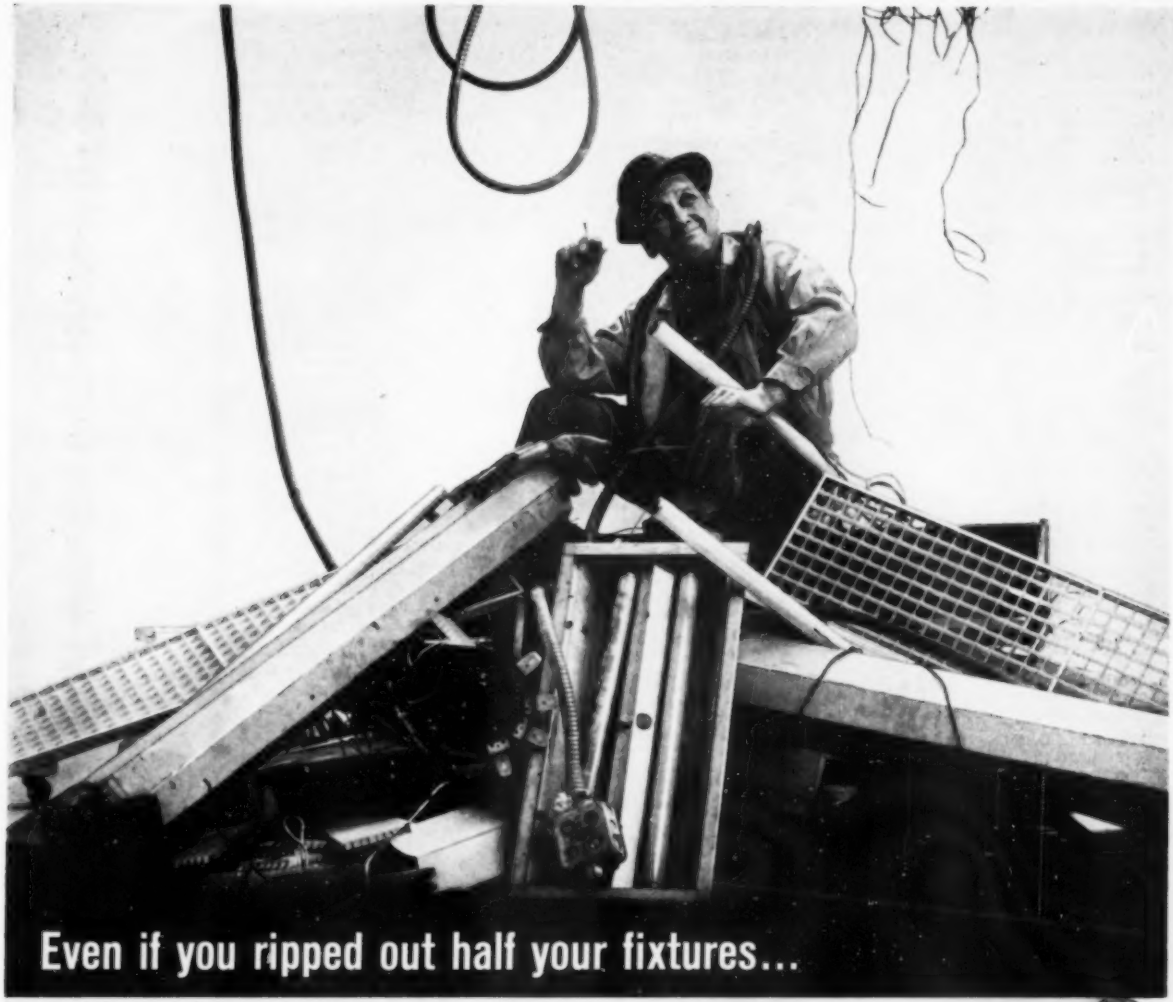
Texas Electric Service Co.
Electric Bldg., Ft. Worth 1, Texas *O. G. Carlson*

(Continued on page 40A)



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(Continued from page 38A)

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U

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Wayne, Mich. — *Hugo E. Rebentisch*

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Universal Mfg. Corp.
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Paterson, N. J. — *Imrich Miller*

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906 Foshay Tower
Minneapolis, Minn. — *O. F. Norgren*

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Salt Lake City 10, Utah — *D. H. White*

V

Vancouver Lighting Co. Ltd.
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John C. Virden Co.
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Cleveland 3, Ohio

John C. Virden Ltd.
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Toronto 16, Ont. — *Cyril E. Birt*

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Richmond 9, Va. — *W. I. Doibeare*

Voigt Co.
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Philadelphia 21, Pa. — *C. J. Frank*

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W

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Wald & Zigas
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Spokane 6, Wash. — *Gordon F. DeFoe*

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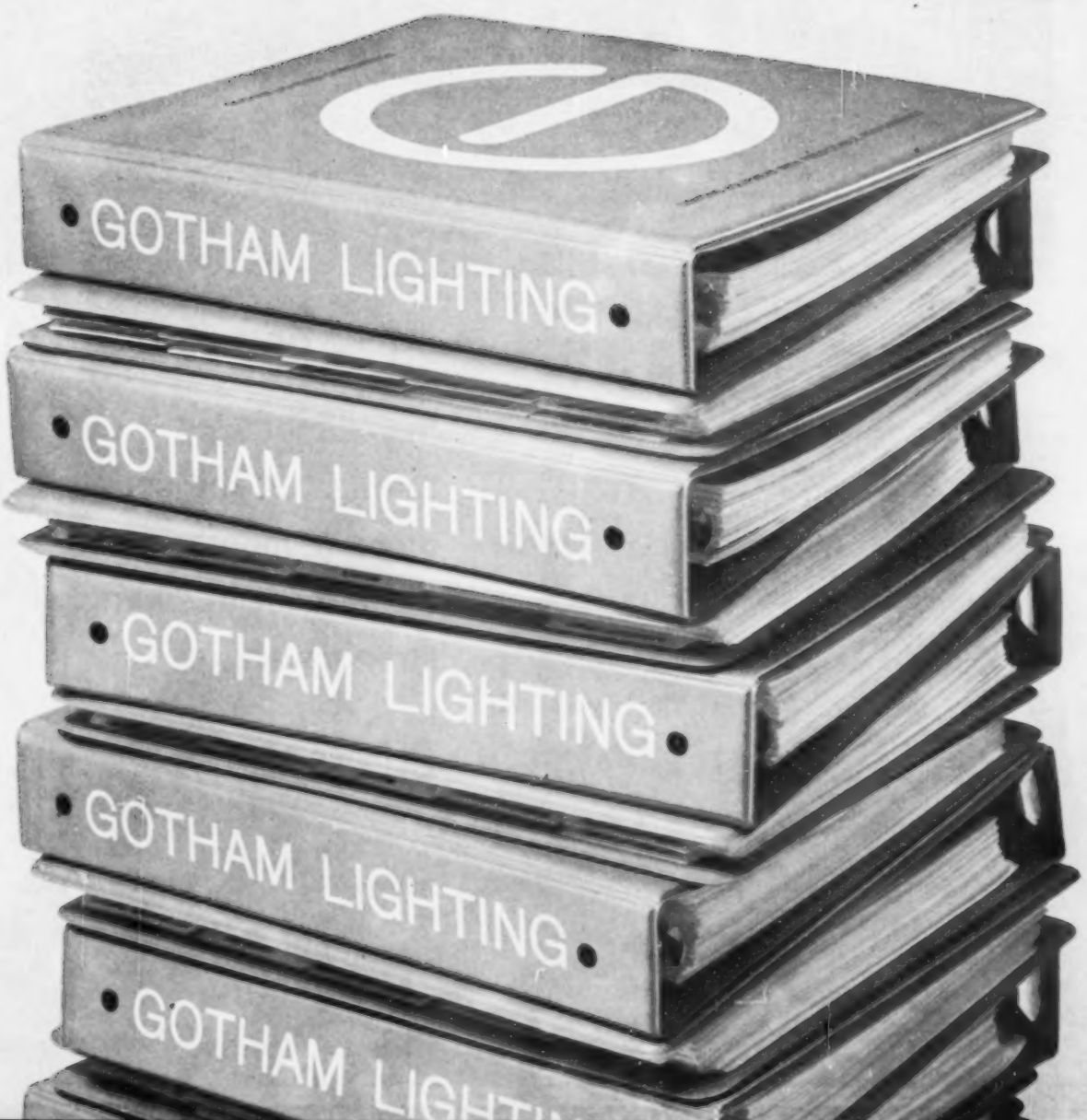
New IES Lighting Fundamentals Course To Be Published Next Month

A completely new IES Lighting Fundamentals Course book will be published by the Society next month. The course, prepared by the Committee on Lighting Education, contains 144 pages, includes 125 charts, diagrams and tables and has a spiral-bound, hard cover. It replaces the original 36-page IES course outline discontinued some years ago.

The new IES Lighting Fundamentals Course, designed for use by students and instructors, is a guide to the basic "facts of light" based on IES principles. It is not intended for use as a self-instruction manual, lighting textbook or handbook of illuminating engineering.

Details on the new course may be obtained by writing to: Publications Sales Office, Illuminating Engineering Society, 345 East 47th St., New York 17, N. Y.

Gotham Lighting Corporation's new catalog, just out, contains 110 pages of photographs, detailed drawings, and technical data relating to Gotham's more than 880 lighting units . . . candlepower distribution curves, rapid estimate charts, coefficients of utilization and efficiency. Gotham invites you to order your copy now. Write to: Gotham Lighting Corporation, 37-01 THIRTY-FIRST STREET, LONG ISLAND CITY 1, NEW YORK.



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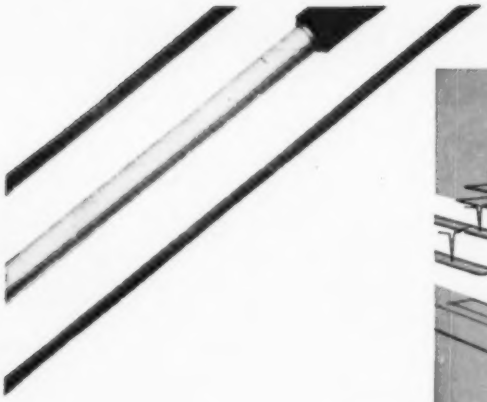

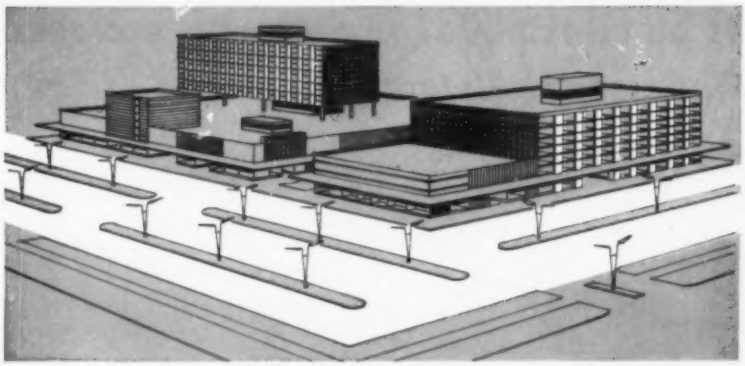

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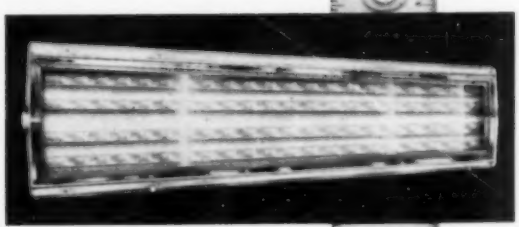

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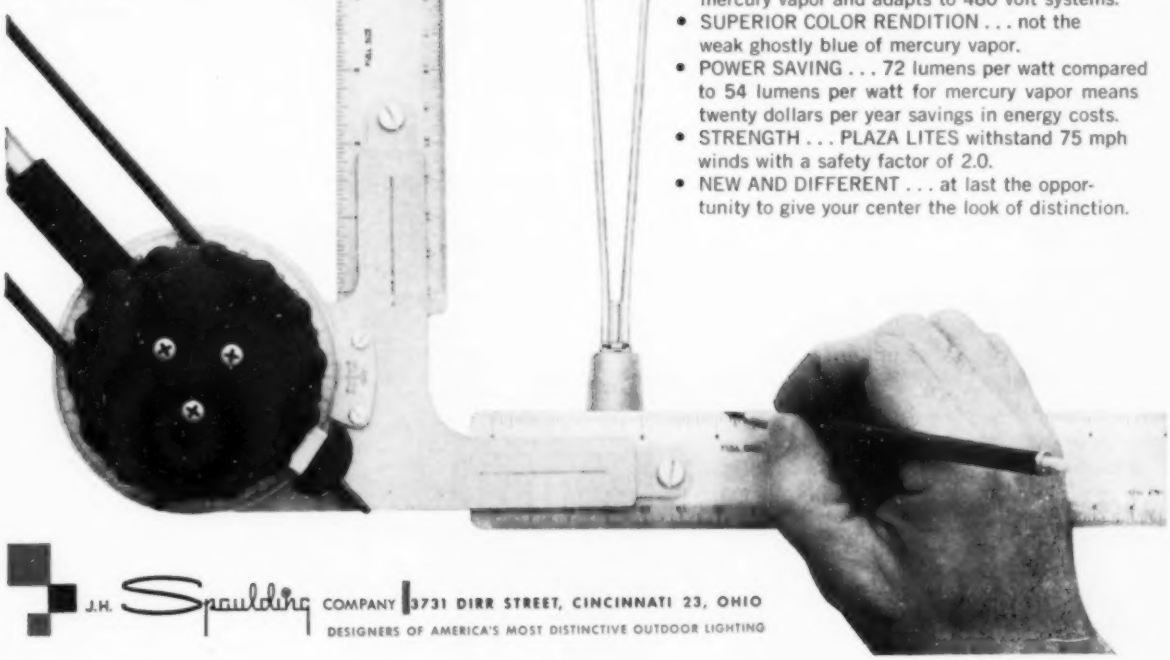

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- Two lamp, 4' and 8' lengths; Rapid Start and Slimline. Clear Acrylic or light stable Polystyrene lenses. 13⅞" width.
- Self Hinging Plastic Enclosure for Each Lamp supported on both edges by continuous flanges in channel—Easy to Maintain—No Sag.
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A truly unique combination of fresh, trim appearance and *seeing comfort* at a *modest* price . . . a natural for on-the-ceiling mounting in newer buildings where ceilings are low.

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Another Miller First! Twin compartments separate and house each of Duplex-a-lite's two lamps in a unique manner that enables the optically designed, prismatic lenses to limit and control most of the light within the highly critical 45°-90° viewing zone. This assures optimum seeing comfort, or Opticomfort. Ceiling and center channel cover are softly illuminated. Enclosures of rigid plastic require no shadow-causing interior framework.

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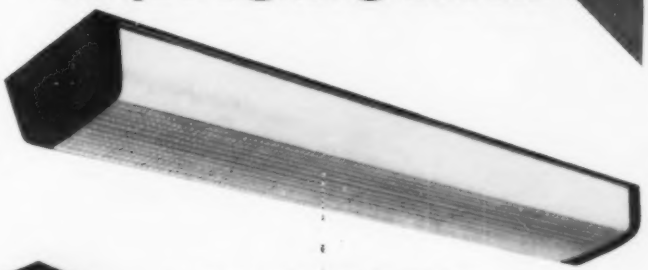
wrap-arounds provide unique 2-color effect with prismatic bottom for more efficient down-light.



2 High Efficiency

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wrap-arounds have prismatic sides and bottom for maximum light transmission and efficiency, yet have excellent 45-degree cut-off for directional light control and low surface brightness.

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extruded diffusers and side panels resist breakage, have non-reflecting surface finish.

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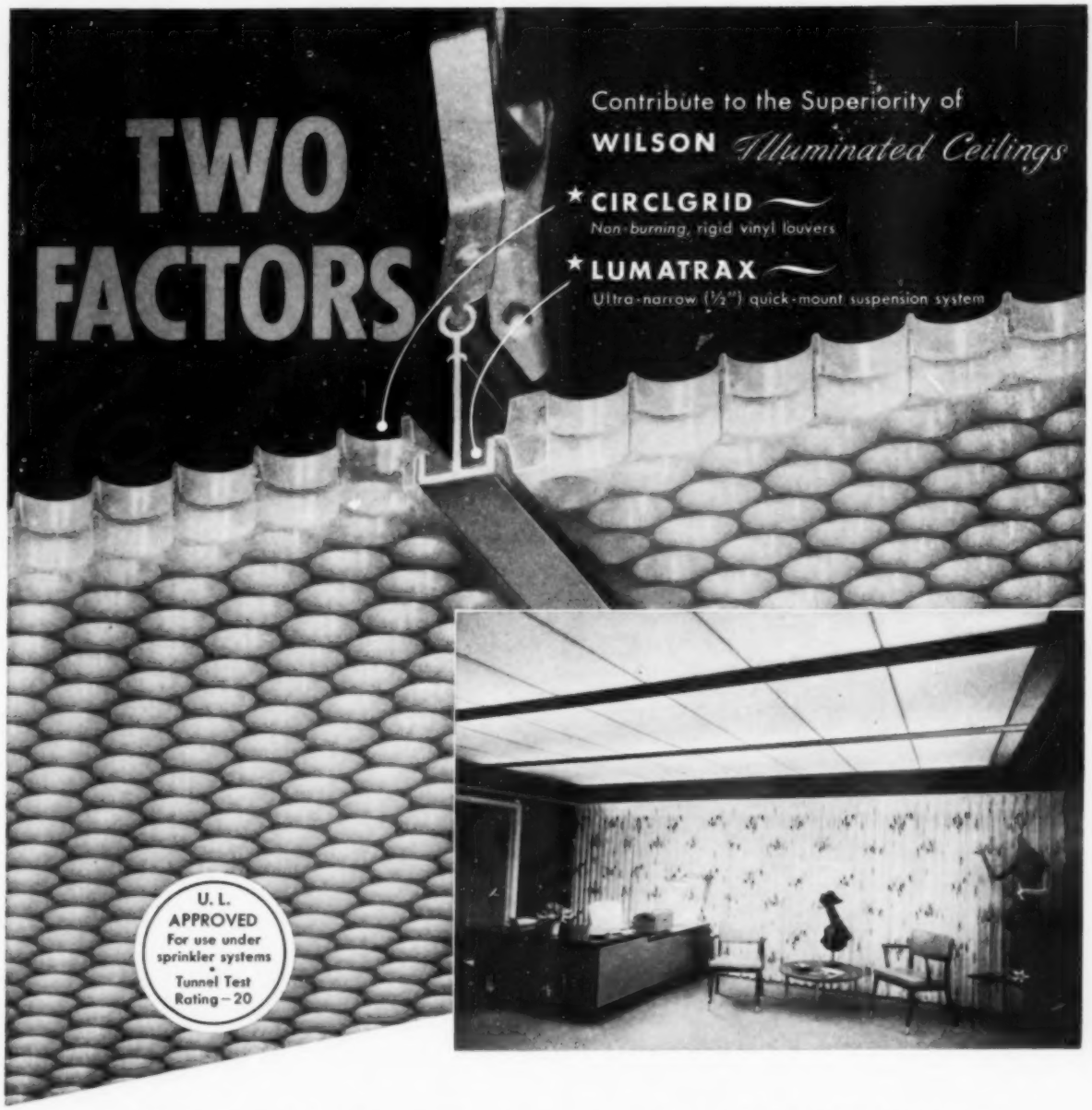

Ageless in beauty . . . versatile in performance, Wilson Illuminated Ceilings are rapidly becoming the architect's favorite lighting system for new construction or relighting.

★CIRCLGRID non-burning vinyl louvers feature thousands of tiny circles in transmitting soft diffused light, permitting intensities ranging to 200 foot candles. CIRCLGRID 2′ x 2′ and 2′ x 4′ panels consist of two non-combustible sheets of rigid vinyl electrically welded for great structural strength . . . with weight of only 3½ ozs./sq. ft.

These popular CIRCLGRID louvers meet rigid fire code standards for metropolitan buildings . . . they possess acoustical properties, permit air conditioning and sprinkler systems to function efficiently and the louvers are easily cleaned by rinsing in mild detergent.

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Prismatic lens
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Fixture Manufacturer: Westinghouse Electric Corp. ● Extruder: KSH Plastics Corp., 10212 Manchester, St. Louis 22, Mo. ● Photo taken in Gateway #4 Bldg., Pittsburgh, Pa.

More Lustrex perma tone is used for lighting fixtures than any other ultraviolet light-stabilized styrene

In crystal, clear white and a complete color range, perma tone exceeds IES-NEMA-SPI JOINT specifications for ultraviolet light-stabilized styrene. With perma tone you can create low cost areas of illumination with good diffusion, dimensional stability, and uniform light distribution. Use of perma tone assures color stability, 2 to 3 times greater resistance to yellowing under ultraviolet light. Its light weight makes for easier handling, installation and maintenance. New Impact Lustrex perma tone provides extra toughness and flexibility for snap-fitting to metal parts, high resistance to abnormal abuse, lighter weight through thinner walls. For free technical report on both regular and impact Lustrex perma tone styrene, including accelerated aging test results and other valuable data on styrene in lighting fixtures, write to Monsanto Chemical Company, Plastics Division, Room 833, Springfield 2, Mass.

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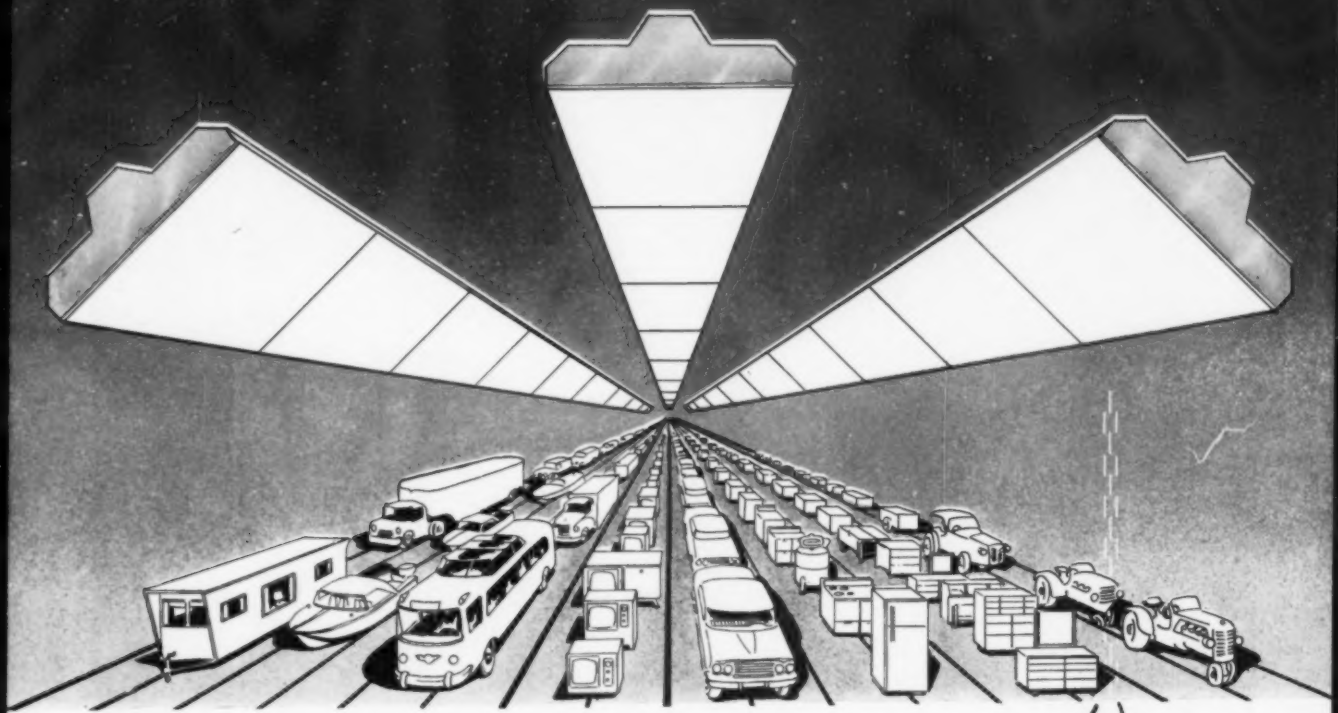
MONSANTO ORIGINATOR IN **PLASTICS**

A new protected lighting fixture for ASSEMBLY LINE LIGHTING

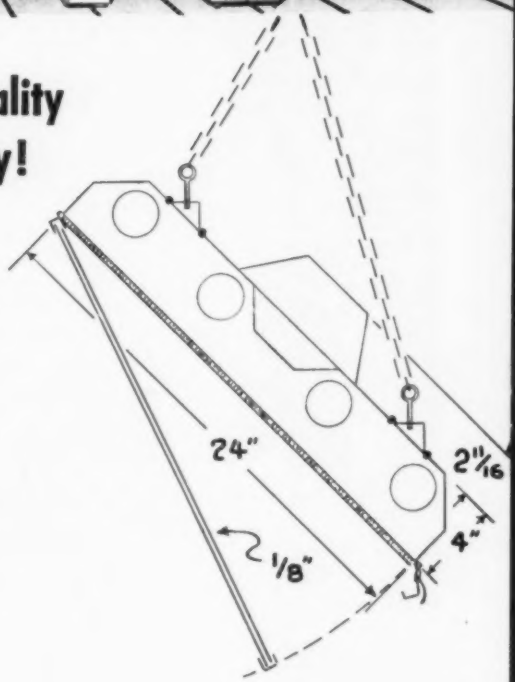


New high-level lighting assures higher quality products and increases production efficiency!

Industry has found that this high-level, high quality lighting is an important factor in increasing the standards of workmanship and greatly reduces the rejections on final inspection of their products. It's common knowledge that adequate lighting also reduces strain and fatigue among workers and contributes greatly to safety and employee morale.

These and many other features found in Paramount quality lighting fixtures are why they pay for themselves quickly.

- **Lighting levels of 500 foot candles readily achieved**
- **Fully gasketed to keep out dirt and dust**
- **Easy access to lamps — hinged shield attached with spring latches**
- **Heavy translucent acrylic shield framed in stainless steel — light, unbreakable and lifts off for cleaning**
- **Separate ballast channel for efficient lamp operation**
- **Versatile — engineered to operate either two or four 1500 Ma lamps**
- **Adaptable for use in continuous rows or specific inspection locations**
- **Conducive to fast rearrangements in assembly line**
- **Approved by Underwriters' Laboratories**



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DO YOU HAVE A LIGHTING PROBLEM? Paramount engineers stand ready to devote their extensive background in lighting design and development to solve your lighting requirements.

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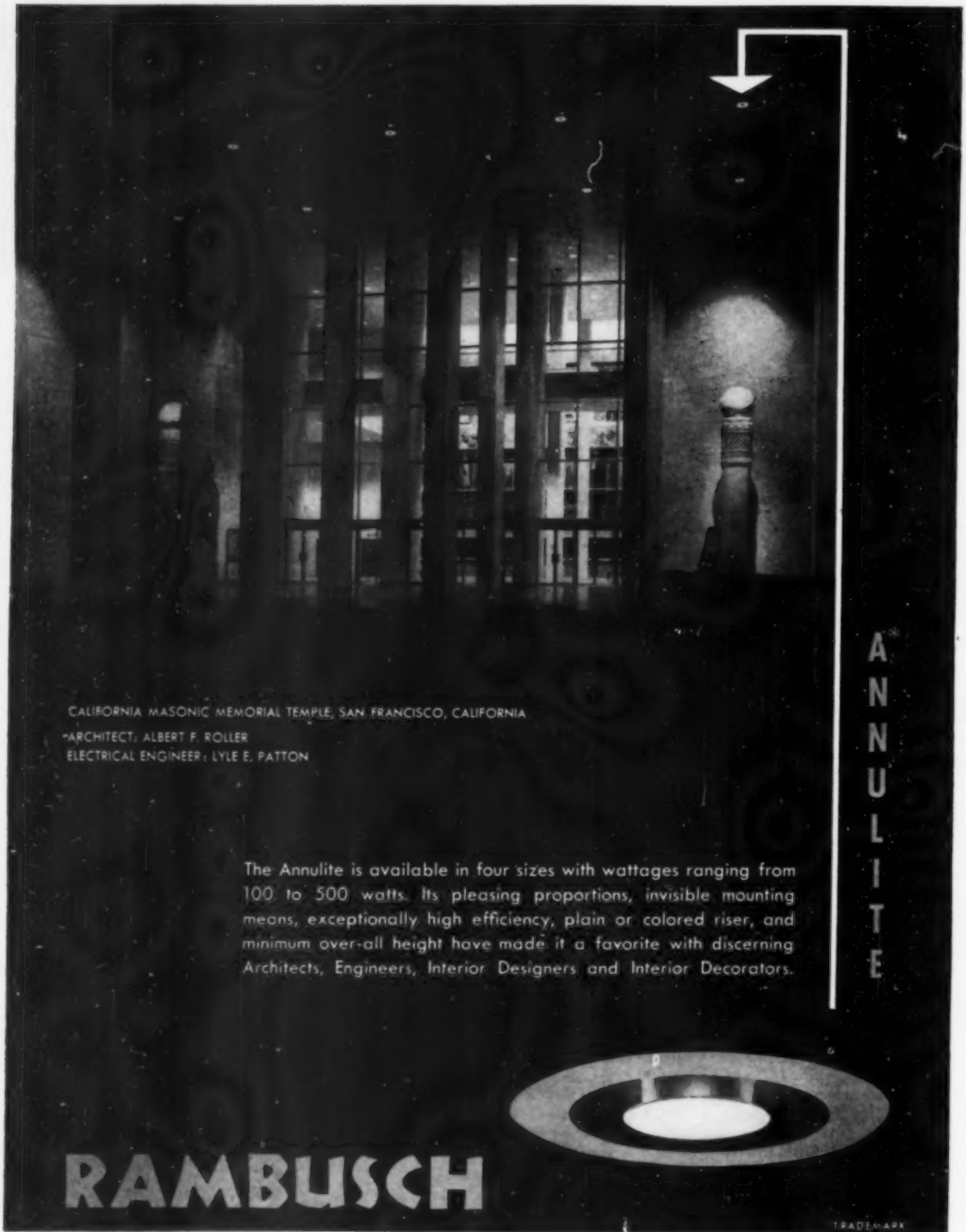
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ARCHITECT: ALBERT F. ROLLER
ELECTRICAL ENGINEER: LYLE E. PATTON
The Annulite is available in four sizes with wattages ranging from 100 to 500 watts. Its pleasing proportions, invisible mounting means, exceptionally high efficiency, plain or colored riser, and minimum over-all height have made it a favorite with discerning Architects, Engineers, Interior Designers and Interior Decorators.
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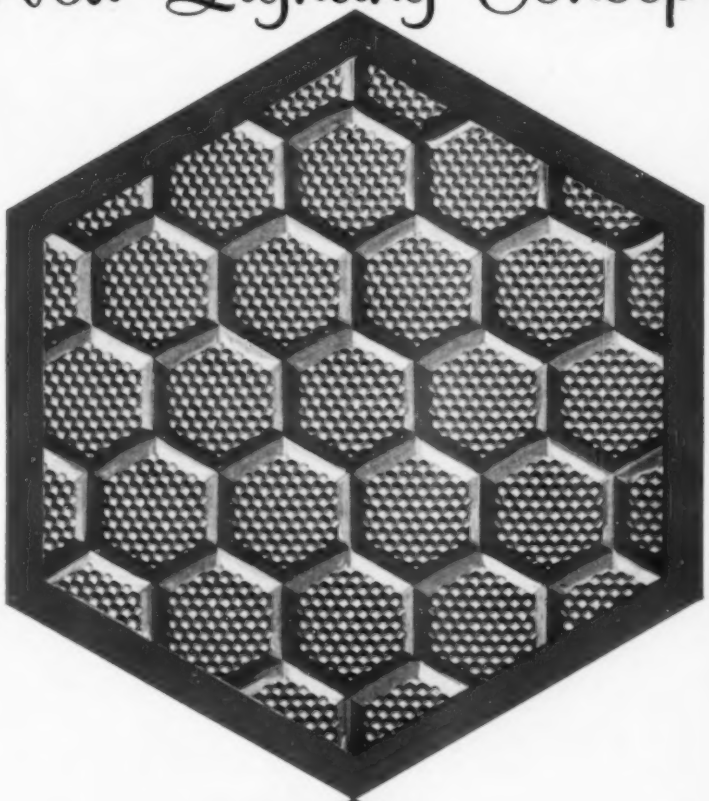

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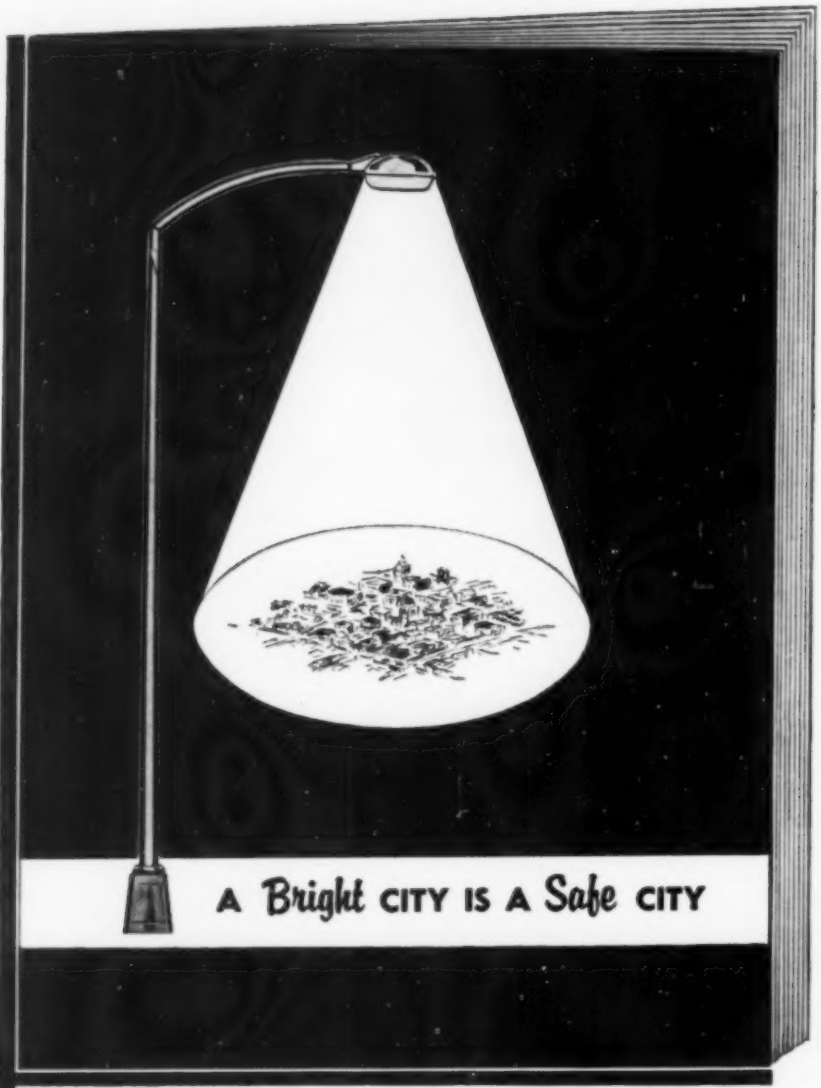

Here's help for those planning street lighting programs. "A Bright City is a Safe City" contains charts and tables on traffic volume, light intensities, pole spacing, mounting heights and other valuable information. It also describes and illustrates relighting projects of specific cities and towns. Get YOUR FREE copy NOW!

Published in the interest of better lighting for our streets and highways.

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C. E. Caveness, North American Aviation Electrical Engineer, and Robert H. Waddell of Smoot-Holman inspect completed installation of Perfect Vision® Luminaires in the Advanced Engineering Office of North American's Space and Information Systems Division, Downey, California.

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- GLARE ELIMINATED. Perfect Vision® Luminaires ("PVs") replaced a lighting system producing excessive glare.
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- CREDITS. Engineered by Walter Hanford and C. E. Caveness of North American's Space and Information Systems Division Engineering Department. Electrical Contractor, James O. Ashcraft, Long Beach, California.

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Manufacturers of Davis Dimmers, Arielites and AD-LAB laboratory panels. Trained representatives throughout the United States and Canada.

How You Can Eliminate Fluorescent Ballast Noise Problems in Your Buildings

Today's trend toward higher levels of illumination—increasing the number of fixtures, lamps, and ballasts, or increasing the wattage of the lamp/ballast systems—makes fluorescent ballast sound a more and more important building consideration.

General Electric wants you to take full advantage of modern lighting levels. At the same time, you should assure yourself that you can solve any audible ballast "hum" problems in your lighting installation with minimum attention and effort.

ALL YOU HAVE TO DO IS . . .

1. Check each lighting installation *while it is still on the drawing board* with the General Electric Sound Rating Calculator* (see below) to predetermine whether ballast noise will be a problem, and . . .
2. Specify the appropriate *General Electric* sound-rated ballasts for the installation.

That's it. By properly following this two-step procedure, you can predict and overcome potential ballast noise problems before they exist.

General Electric, with five years of highly successful experience in the G-E Ballast Sound-control Program, is confident that this procedure will solve your ballast noise problems. Here's how the program works . . .

THE GENERAL ELECTRIC BALLAST SOUND RATING CALCULATOR is based on data gathered from hundreds of lighting installations over a period of many years. It provides a reliable index of the magnitude of audible ballast sound when room variables such as size, ceiling materials, and number of fixtures and ballasts are known. These calculations are keyed to . . .

GENERAL ELECTRIC'S BALLAST SOUND RATING SYSTEM. This system, initiated by General Electric in 1951, establishes a rigid scale of sound magnitude. Most General Electric ballast designs are carefully compared with this scale in actual fixture tests conducted in the only known anechoic sound chamber in the ballast industry. Each ballast design is thus "Sound-rated" "A" through "F," . . . "A" being quietest, and "F" being least quiet.

The sound-rating scale—and for that matter, the whole sound-control program—is not an industry standard. General Electric has established its own sound standards, and compares the performance of *General Electric ballasts* with these standards.

But the Sound-control Program doesn't end here. In order to give you further assurance that you get the "quiet" you specified, General Electric has established an elaborate . . .

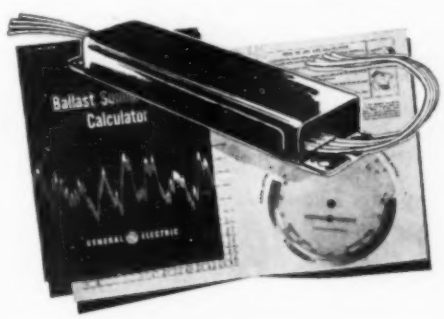
DAILY PRODUCTION SOUND AUDIT. A *daily* sample of production units is carefully compared in sound performance with the G-E sound-rating standard—under controlled conditions in the anechoic sound chamber. This close check on possible manufacturing variations means you get the kind of sound performance that your Sound Rating Calculator promised. The final element in G.E.'s Sound-control Program is . . .

BASIC ENGINEERING DESIGN. General Electric ballast design engineers are constantly examining today's ballast circuitry, trying to further minimize the inherent magnetic "hum" of core and coil assemblies. An example of the results of this engineering effort is the recently announced "A" sound-rated 40-watt, rapid-start line. This popular family of General Electric ballasts was granted a G-E "A" sound rating as a result of *basic circuit design* that produced a smaller and quieter core and coil.

Materials are also an important sound-control factor. For example, the resilient asphaltic filling compound used in General Electric ballasts maintains excellent sound-absorbing characteristics over the entire life of the product. The new General Electric Bonus Line† ballasts, using this proved asphaltic filling compound, are designed to provide protection against objectionable ballast end-of-life leaking and smoking, without sacrificing any sound performance.

All this means that General Electric is truly concerned about ballast sound—and is investing heavily so you can stop being concerned with it yourself. Mail the coupon today for your General Electric Sound Rating Calculator, and start using it immediately. For more details, ask your local General Electric Ballast Sales Engineer, or write Section 403-02, General Electric Company, Schenectady 5, New York.

† Trade-mark of General Electric Company.



GENERAL ELECTRIC SOUND RATING CALCULATOR

This ingenious device was designed so you can always predict *with 100% accuracy* whether a lighting installation will present noise problems. You can use it for any indoor lighting application from extra-quiet broadcast studios to noisy offices. On the easy-to-use circular slide rule you simply (1) dial in room "constant," (ability of room to absorb noise); (2) number of ballasts and their sound rating and (3) given ambient noise level for your application. Steps 1 and 3 are *immediately determined* from tables which are part of calculator.

PLEASE SEND ME THE FREE BALLAST SOUND RATING CALCULATOR

Mail coupon to: General Electric Co.,
Section F 403-02, Schenectady 5, N. Y.

NAME_____

COMPANY_____

ADDRESS_____

CITY_____

STATE_____

* Copyright 1956, General Electric Co.

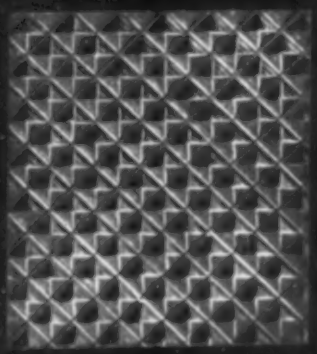
Progress Is Our Most Important Product

GENERAL ELECTRIC

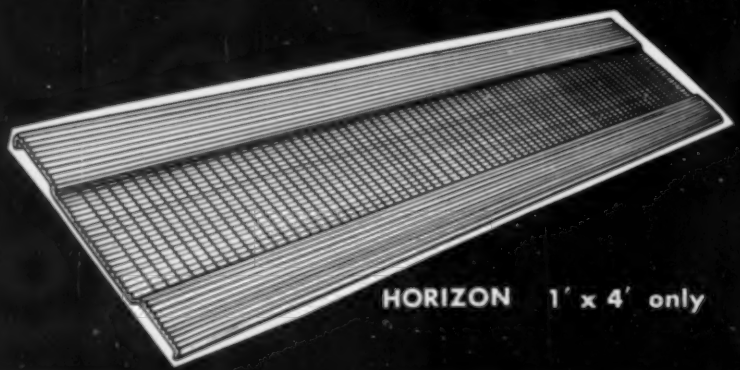
Sandee POLY-LITE

STOCK EMBOSSED PATTERN SHEETS

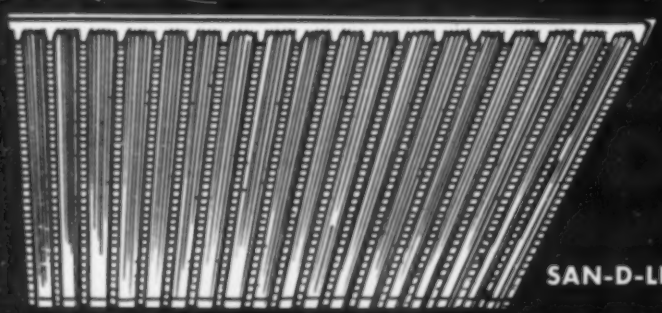
NO TOOL CHARGES
IMMEDIATE DELIVERY FROM STOCK
AVAILABLE IN 1'x4' and 2'x4' SIZES



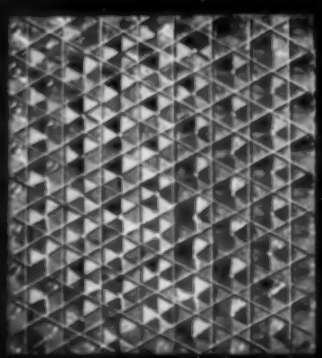
S-60



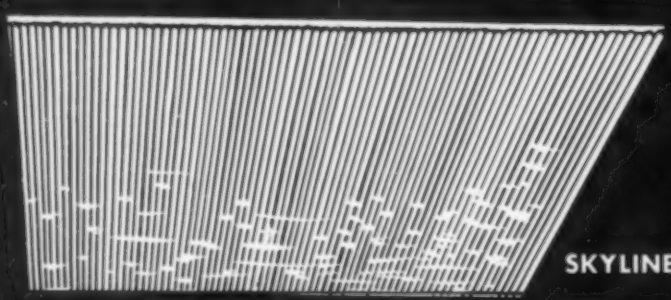
HORIZON 1' x 4' only



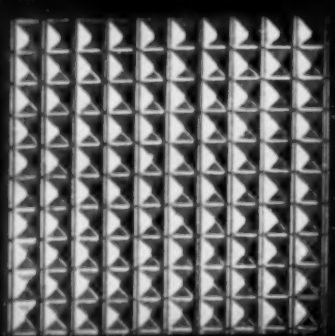
SAN-D-LITE



S-55



SKYLINER



S-40

Whether it is one of these stock embossed lenses or an intricate multi-color extrusion . . . Whatever you require for your fixtures . . . Sandee can supply your most exacting needs . . . promptly, accurately and economically.

Write for our free brochure of lighting sections . . . samples on request.

Sandee Manufacturing Company
735 South Karlov Avenue
Chicago 24, Illinois
NEvada 8-6655

WHAT A DIFFERENCE!

What a beautiful difference

P & K ALL-ALUMINUM LIGHTING STANDARDS

can make in any community

You're looking down Broadway, the main business street of Needles, California. Ordered by the City Council as part of a relighting program, the installation, made by the California-Pacific Utilities Co., consisted of twenty seven P & K 30 foot tapered aluminum lighting standards. As you can see from the photos above, the difference is immediately apparent. The result is greater safety for the community at night and the beautiful modern appearance of the new standards by day. Of course, no painting ever required. Why not write for P & K's new brochure ALS-5 for a wealth of helpful information in your street lighting plans.

P&K **PFAFF & KENDALL** 84 Foundry Street, Newark 5, N. J.

Branch Sales Office: San Jose, California
In Canada: Powerlite Devices LTD., Toronto, Montreal, Vancouver
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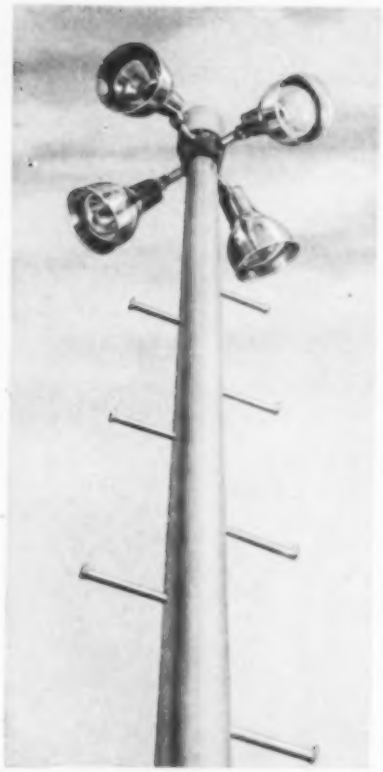

ABSOLUTELY NO MAINTENANCE

You are looking at Stonco sealed-beam mercury vapor floodlights.

Hermetically sealed inside each lamp is a brilliant silvered reflector.

The reflector stays brilliant because nothing ever touches it. Not dust, dirt or grime. Not even smoke, soot or chemicals in hazardous areas.

You climb the pole only to change lamps. This could easily be once every five years. Probably longer.

(Conventional floodlight reflectors lose up to 15% efficiency if not cleaned every three months.)

What do you want from a mercury vapor floodlight? Higher lumen output? Longer lamp life? Lower power consumption?

Stonco sealed-beam mercury vapor gives you all of this, at far less cost. Plus . . .

Absolutely no maintenance.

STONCO lighting

Write for Catalog MV

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KENILWORTH, NEW JERSEY

(*Continued from page 26A*)

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Huffnagle, D. R., Philadelphia Electric Co., Philadelphia, Pa.
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Associate Member:
Meiier, C. M., Lighting Maintenance Co., Portland, Ore.

(*Continued on page* 60A)

Rules and Regulations Relating to the Use of Submersible Lighting for Swimming Pools, Reflector Pools and Display Fountains.

—

Bulletin No. 17

—

17.1 General—Effective as of this date, the use of 120-volt lamps when assembled in submersible lighting units, for the illumination of swimming pools, reflector pools or display fountains, whether they are intended for side wall or pedestal mounting, is hereby prohibited.

17.2 Voltage—The permissible voltage that may be applied to lamps used for such application shall not exceed 12 volts.

17.3 Transformers—a. Step-down transformers used in conjunction with such lighting units shall be of the two-winding, isolating type and having a grounded metallic shield between the primary and secondary windings to prevent accidental contact between windings under fault conditions. b. Transformers shall be located remotely from the lighting units which they supply, and overcurrent protection shall be provided in both primary and secondary windings.

17.4 Swimming pools, reflector pools, or display fountains presently under constru

LIFESAVER

Underwater lighting is serious business.

Deadly serious.

Cutting corners can cost lives.

Precisely why the Stonco line is solid cast bronze. Porosity-tested. With a special low voltage transformer for safety plus.

(We've tamed the high voltage. Isolated it with a grounded shield that stops cross-over from primary to secondary. Harnessed it with a fuse factory-sealed to guard against do-it-yourself electricians.)

Even the deck box is gasketed watertight fore and aft. Keeps wiring bone dry. From surface slop, seeping water, or pool overflow caused by flash floods.

No wonder Stonco submarine lighting meets all the safety codes.

Incidentally, even our fountain lights are available low voltage.

Fish have to live too.

STONCO lighting

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(*Continued from page 59A*)

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Dillon, H. K., Electrical Products Consolidated, Seattle, Wash.
Lazara, H. L., State of Washington, Department of Highways, Olympia, Wash.

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SOLITROL lighting systems... offer unprecedented control flexibility

Now, for the first time, you can buy your *complete lighting control system* from Ward Leonard—a name made famous through years of experience in the manufacture of dimming components.

SOLITROL lighting systems were research developed for extreme operating versatility . . . in scene presetting . . . . . cueing . . . fading, and individual mastering. SOLITROL's functional, modular "packaging" lets you select the system complexity or simplicity *you* need—no more, no less.

There's a SOLITROL system, utilizing silicon controlled rectifier dimmers, for every application . . . from the largest theatre or civic center, to the smallest club, church or school. 1.6

Write for descriptive literature. Ward Leonard Electric Co., 74 South Street, Mount Vernon, New York. (In Canada, Ward Leonard of Canada, Ltd., Toronto.)

RESULT-ENGINEERED CONTROLS
WARD LEONARD ELECTRIC CO. MOUNT VERNON NEW YORK
RESISTORS • RHEOSTATS • RELAYS • CONTROLS • DIMMERS

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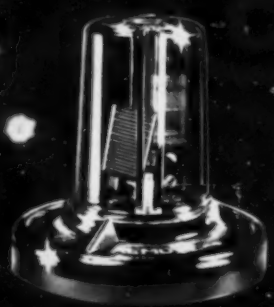
(*Continued on page 63A*)

Precision automated lighting

cuts cost
accidents
security risks



One user bought two Precision controls for $35 — saves 3000 watt hours of power monthly. Other users cut pilferage and accidents to zero.

Installed in minutes, field-proven Precision photocontrol turns lights **on at sunset — off at sunrise** automatically. Needs no maintenance, pays for itself because lights are on only when needed.

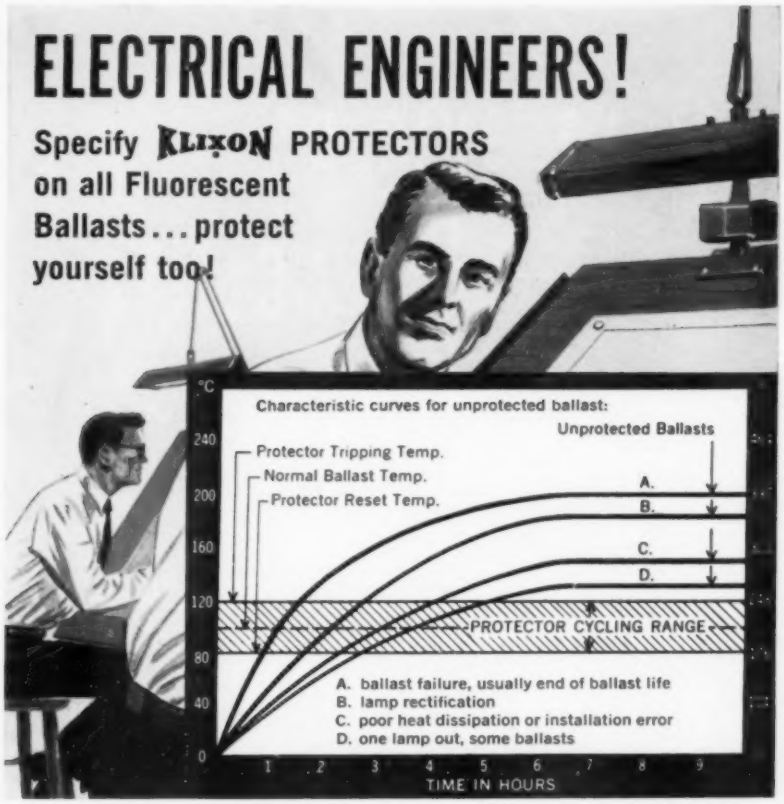
Write — wire for details.

PRECISION
MULTIPLE CONTROLS, INC.
Ridgewood, New Jersey, U.S.A.

The difference between night and day

ELECTRICAL ENGINEERS!

Specify KLIXON PROTECTORS on all Fluorescent Ballasts... protect yourself too!



In the installation and operation of fluorescent fixtures (see chart) you can protect your own reputation and give your client important extra benefits at low, low cost . . . simply SPECIFY BALLASTS WITH KLIXON PROTECTORS!

KLIXON® PROTECTORS ASSURE . . .

- Ballasts and fixtures that operate within U/L temperature limits . . . positive protection against overtemperature, overcurrent, or both.
- Cool running installations . . . rapid response against overheat allows correction while contractor is still on job.
- Maximum ballast life . . . external faults can not cause dangerous overheating. When corrected, ballast operates normally again. An internal fault signals need for ballast replacement . . . with protector keeping temperature at a safe level until this is convenient.
- No dripping compound, fires or violent failures at end of ballast life.

These KLIXON benefits are not attainable with fuse protection. Ballasts under some fault conditions draw less than full rated current, still deliver light, but may have a case temperature twice the allowable U/L limit for normal operation. Thus BALLAST OVERHEAT PROTECTION is a TEMPERATURE, not a CURRENT problem.

Ballasts equipped with KLIXON Protectors can be supplied to your fixture manufacturer by all six leading makers of ballasts. Simply use specifications shown here. Write for full engineering details.

USE THIS KLIXON PROTECTION SPECIFICATION

"Ballast shall be thermally protected against overheating by a built-in automatic reset overheat protector sensitive to both winding temperatures and current which will prevent winding temperatures from exceeding 120°C with the exception that the peak temperatures in the first few cycles may exceed this. The protector must allow the winding temperatures to reach 105°C minimum under normal conditions in a 40°C ambient without opening the circuit to the primary winding, and after opening shall not reclose above 85°C. Fixtures must be so designed that ballast coil temperatures shall not exceed the U/L limit of 105°C in a 40°C ambient."

METALS & CONTROLS INC.
5409 FOREST STREET • ATTLEBORO, MASS.
A CORPORATE DIVISION OF
TEXAS INSTRUMENTS
INCORPORATED

LIGHT SHIELDS from CRESCENT PLASTICS*

meet your 3 big needs:

QUALITY · PRICE · DELIVERY

* **ONE OF AMERICA'S LARGEST CUSTOM EXTRUDERS** — suppliers for major national manufacturers since 1949.

Let us quote your current production parts or new part designs—complete technical and engineering services.

CRESCENT PLASTICS, INC.
955 Diamond Avenue
Evansville 7, Indiana
Phone: HA 4-7911

EMPLOYMENT OPPORTUNITIES

LIGHTING SALES ENGINEERS

Manufacturer since 1895 desires lighting sales engineers with following among Architects, Engineers, Distributors, etc. Engineered line of Commercial Fluorescent and Incandescent lighting fixtures. 78-page hard-back catalog. Corning and Holophane diffusers. Many territories open. Forward complete resume. State lines carried. The Kayline Co., 1241 E. 45th St., Cleveland 14, Ohio.

AGENTS WANTED

To represent line of formed diffusers and new lens units for ceilings and fixtures. Backed by program of national advertising and guarantees. Must now be contacting fixture manufacturers. Some territories still open. LIGHTONICS, Box 7211E, Oakland 1, Calif.

REPRESENTATIVES WANTED

Luminous Ceiling representatives wanted for Neo-Ray's new WOOD-BEAM luminous ceiling—SCALLOP-CEL, TEXTUR-CEL, INTRA-CEL, INTRA-TEX aluminum louvered ceilings. Heavy architect-designer promotional backing in Architectural Record and Interiors each month. Engineering literature for continuous specification by architects and engineers. Territories open include CHICAGO and ST. LOUIS. Contact:

Sales Manager
Neo-Ray Products Inc.
315 East 22nd St.
New York, N. Y.

LIGHTING SALES REPRESENTATIVES WANTED

For quality line of ARCHITECTURAL COLD CATHODE LIGHTING for Coves, Luminous/Louverall Ceilings & Walls and Custom Application. Knowledge and experience in lighting sales engineering type of contacts with architects, engineers, lighting consultants and electrical contractors is a prime requisite. All territories open except greater New York City, Washington, D. C., Conn. and New England areas. State territories covered and lines carried. Address Box 499, Publications Office, Illuminating Engineering Society, 345 E. 47th St., New York 17, N. Y.

ILLUMINATING ENGINEER

A large Midwestern lighting equipment manufacturer has opening for a qualified illuminating engineer to specialize in interior lighting application design work. B.S. in E.E. with option in illumination desirable, along with a fair amount of practical experience. Westinghouse Electric Corporation, Lighting Division, Box 5817, Cleveland, Ohio.

REPRESENTATIVES WANTED

Specification grade commercial fluorescent and incandescent lighting equipment. Standard and custom designs. Progressive program of fixture design and catalog presentations for the architect and engineer. Continuous development of new and original equipment. Complete design and quotation services. Prompt replies to correspondence and inquiries. 33-year history of service to major national users. Contact Kent Lighting Corp., 500 Johnson Ave., Brooklyn 37, N. Y.

AGENTS WANTED

To represent Cylindricell luminous ceilings with fixtures using new variable thickness diffusers. Needs no grid system. A fast-selling, highly profitable line for qualified agents . . . over 250,000 square feet already sold. Your sales efforts backed by comprehensive literature, sales aids, national advertising; tight specs, and direct factory assistance when needed to land the big jobs. Many territories still open, including Seattle, Michigan, and Ohio. Write United Lighting & Ceiling Company, 2828 Ford St., Oakland 1, Calif.

(Continued from page 60A)

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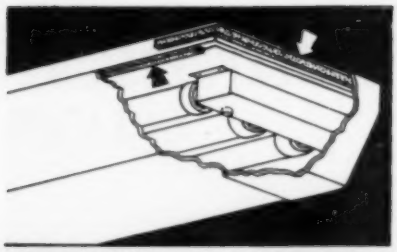

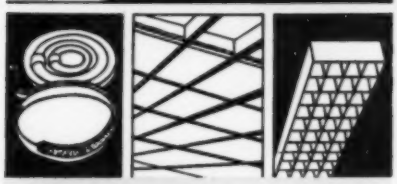

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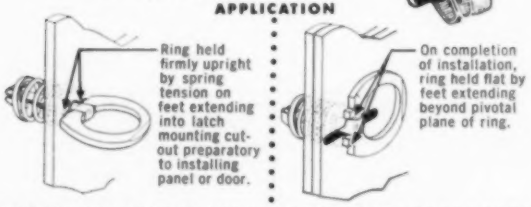
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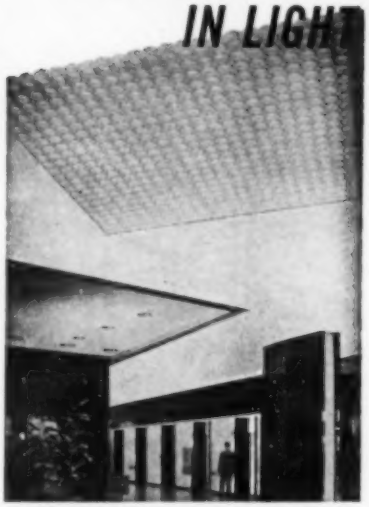

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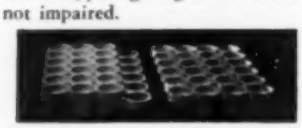

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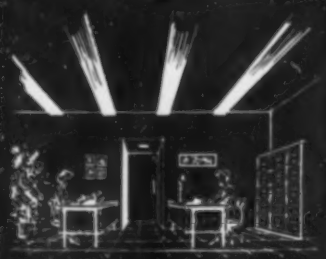

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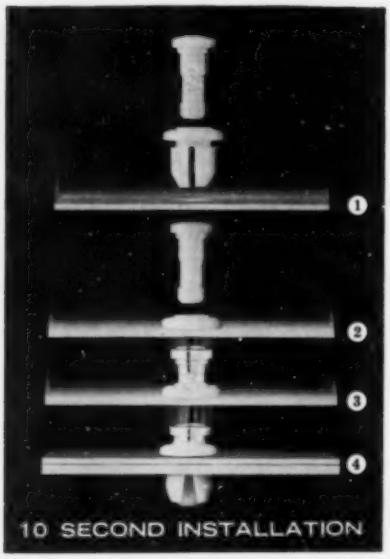

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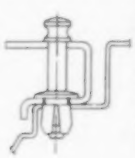

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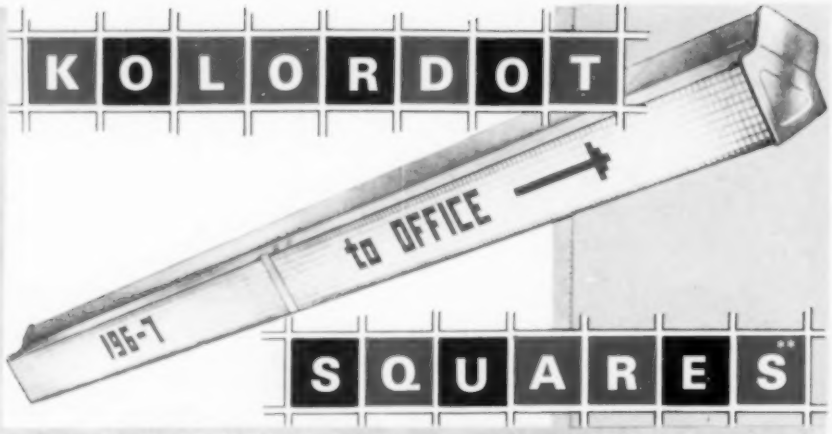

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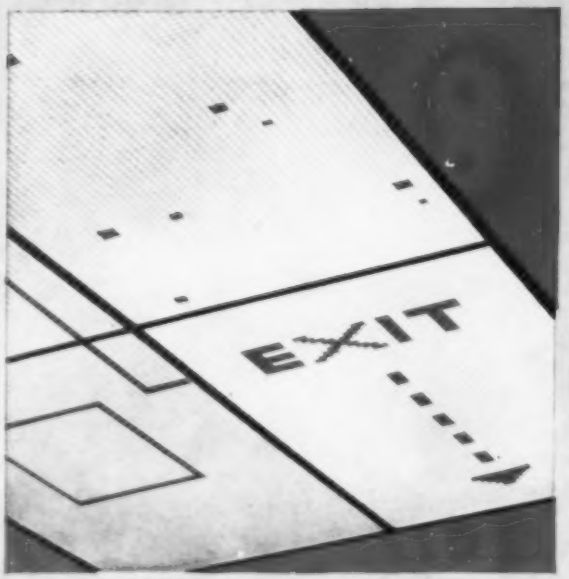

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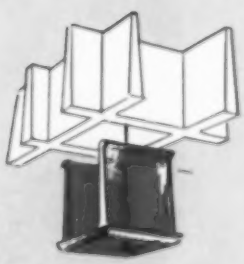

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